Royal Commission on the Future
of the Toronto Waterfront

Shoreline Regeneration

for the Greater Toronto Bioregion

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A Report Prepared for
The Royal Commission
on the Future of the Toronto Waterfront
by the Shoreline Regeneration Work Group

September 1991

Royal Commission on the
Future of the
Toronto Waterfront

CANADA

Ontario

Commission royale sur
l'avenir du
secteur riverain de Toronto

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Executive Director and Counsel
Ronald L. Doering

Commissaire
L'honorable David Crombie, P.C.

Directeur exécutif et Conseiller juridique
Ronald L. Doering

Dear Colleague,

I am pleased to send you this copy of ***SHORELINE REGENERATION for the Greater Toronto Bioregion.*** This report was prepared to help the Commission respond to the request by the Ontario Minister of the Environment for advice on "the policies, practices, technology, and methods available to regenerate shoreline areas." If you wish additional information on these meetings, please contact the Royal Commission offices.

This document represents the opinion of the Shoreline Regeneration Work Group, not the Commission. By providing substantial background concerning shoreline modification, and outlining issues and options, it will stimulate and focus discussion of this complex but important subject.

I look forward to hearing from you.

Cher collègue,

Je suis heureux de vous transmettre un exemplaire du rapport intitulé ***RÉGÉNÉRATION DU LITTORAL de la biorégion du Grand Toronto.*** Ce rapport a été préparé pour aider la Commission à répondre à la demande du ministre de l'Environnement de l'Ontario qui désirait des conseils sur "les politiques, les pratiques, la technologie et les méthodes disponibles pour remettre les secteurs du littoral en état." Veuillez vous adresser aux bureaux de la Commission si vous désirez des renseignements additionnels.

Ce document représente le consensus du groupe de travail sur la régénération du littoral et non l'opinion de la Commission. Il fournit, néanmoins, une documentation importante sur la transformation du littoral et souligne des problèmes et des options qui devraient alimenter et polariser la discussion sur ce sujet complexe mais très important.

En espérant recevoir bientôt de vos nouvelles, je vous prie d'agréer, cher collègue, mes cordiales salutations.

David Crombie

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Gary Boyd has worked on Great Lakes shoreline issues for over 18 years. From 1973 to 1989 he worked at the Canada Centre for Inland Waters on various projects including the Great Lakes Shore Damage Survey, Coastal Zone Atlas, Shore Erosion Monitoring Program, IJC Reference, and coastal zone management issues. A recipient of the Conservation Award for his dedication to shore management in the Maitland Valley Conservation Authority, he has made significant contributions to advancing scientific understanding and coastal management in Ontario. Mr. Boyd has recently been appointed Science Policy Advisor for the Department of Fisheries and Oceans in Ottawa.

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Ron Kanter is a lawyer who practices land-use planning, municipal, and environmental law with the firm of Woolley, Dale & Dingwall, and teaches a course in law & planning at the Faculty of Law, University of Toronto. He has previously served as an elected member of Toronto City Council, Metropolitan Toronto Council, and the Ontario Legislature. As a provincial legislator, he wrote *Space for All: Options for a Greater Toronto Area Greenlands Strategy*, in which he suggests that a balance can be struck between environmental protection and development.

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Walter Kehm is the director of the School of Landscape Architecture at the University of Guelph. His research interests are involved with the integration of ecological factors in the shaping of policy, plans, and designs for human settlements. Particular research interests are the protection of agricultural land, the preservation of existing wetlands, and their restoration in degraded areas. Current work includes analyses of watershed and shoreline areas to assess their potential for the creation of greenway systems and open space corridors and the development of countryside open space plans to protect the rural environment.

Dr. John Lawrence

Dr. John Lawrence received his doctorate in electrochemistry and chemistry from the University of Bristol in the United Kingdom. He is currently the

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Serge Metikosh is Senior Fish Habitat Biologist with the Department of Fisheries and Oceans at the Canada Centre for Inland Waters in Burlington. His main area of interest is the protection and rehabilitation of fish habitat in Ontario. Much of his work involves the review of projects likely to affect fish habitat and developing methods to mitigate their impact or compensate for losses of fish habitat that may result.

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Susan Richardson holds a degree in physiology and biochemistry from the University of Toronto. She has extensive experience in municipal planning as well as waterfront and parks issues. Susan was seconded to the Olympics Bid Task Force in 1989-90, and currently is Director of Park Planning for the City of Toronto.

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Douglas Wilkins is the principal of W.D. Wilkins and Associates, a consulting firm that for the past decade has been undertaking scientific and engineering investigations in the aquatic environment. From 1970 to 1980 he worked in the Water Resources Branch of the Ontario Ministry of the Environment and examined in scuba gear much of the Greater Toronto Area littoral zone. His areas of specialization include the water resource impacts of marine construction activity and the effects of coastal processes on trace contaminant distribution.

ACKNOWLEDGEMENTS

The Shoreline Regeneration Work Group received assistance and valuable advice from many individuals and organizations in the course of its investigation. Without their co-operation and the benefit of their experience, it would not have been possible to prepare this document in the allotted time.

The Work Group greatly appreciates the help of the individuals who participated in panel discussions, made presentations, and otherwise assisted, including:

City of Mississauga: Dirk Blyleven

Conservation Authorities panel: John Hall (Halton Region Conservation Authority), Ken Owen (Credit Valley Conservation Authority), Brian Denney (Metropolitan Toronto and Region Conservation Authority), Bill Campbell (Central Lake Ontario Conservation Authority)

Construction and Development Industry panel: Sandy Cochran, David Frame, Ira Greenspoon, Paul Lisanti, Maureen McCauley, Peter Ramsay, George Rumble, David Sefton

Consultants and Experts: Phil Beinhaker, Joe Berridge, Kate Davies, Cameron Davis, Don Dewees, Doug Hallet, Dan McGillivray, Sarah Miller, Jim Nash, Nancy Patterson, Peter Pickfield

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Regional Municipality of Metropolitan Toronto: Lynn Morrow, Glenn Miller, Robert Petrella, John Gartner, Mike Thorne, Ed Mickiewicz

It was a great pleasure to work with the dynamic and talented staff of the Royal Commission on the Future of the Toronto Waterfront. David Carter, Suzanne Barrett, Soo Kim, Gord Garland, Irene Rota, Jiin Kim, Janet Hollingsworth, and Anne Dixon worked particularly closely with the Group and quickly earned our respect and appreciation.

EXECUTIVE SUMMARY

In the 15,000 years since the glaciers receded, the shoreline of Lake Ontario has evolved continuously — the result of the action of water and waves, wind and ice, plants and animals, frost and fire. Human settlement and increasing urban and industrial development have altered and accelerated the changes. Many of those alterations — such as dredging to open channels for navigation, filling wetlands and shallow areas to build transportation corridors and create land for commercial development — have contributed to the economy of the region. New habitat has been created on the Leslie Street Spit and at Humber Bay, and fill placed in the lake has provided the base for waterfront parks that have expanded both commerce and enhanced opportunities for boating, and lakeside recreation for tens of thousands of people each year. Entertainment, culture, and commerce have benefited from facilities like Ontario Place and Harbourfront, both created through lakefilling.

Filling the lake has had another benefit: it has been an inexpensive, convenient means of disposing of excavated soils produced by the intensive development of downtown Toronto.

Unfortunately, these human interventions have had a darker side. A substantial proportion of the excavated material used for lakefill was contaminated with lead, other heavy metals, and organic materials that found their way into the lake sediments and the food chain. This material, combined with the much larger sources of pollution, the sewage treatment plants, storm sewers, and urban rivers, has degraded the water quality along the shore. The combined impact of urban development — filling wetlands and river estuaries, and armouring for erosion control, in addition to vast quantities of silt released from lakefill sites — has damaged much of the natural habitat both above and below the waterline.

The commercial lake trout fishery has been lost. Artificial headlands and structures block the movement of sand, and limit the lake's ability to rinse its shoreline. Beaches are closed for days after heavy rain, and toxic contamination limits the consumption of many fish. Birds with strange deformities are observed, and there are concerns about the quality of water drawn from the lake for drinking and bathing.

The public's desire for the benefits of shoreline modification — including the recreational, economic, and aesthetic opportunities afforded by parks and access and boating — is in conflict with an equally powerful desire to avoid the negative consequences of previous projects. How can we make the shoreline better: healthier, more accessible, and more enjoyable, without making it worse — uglier and more polluted? This dilemma is the reason shoreline regeneration is an issue today.

Clearly, regeneration will not be accomplished by persisting with the pattern of the past. The remaining natural shoreline must be skilfully protected, and

some portions should be rehabilitated. If we are to prevent collateral damage in future, we must understand its root causes now.

In this study, the Work Group found that most of the unfortunate effects of shoreline modification could be traced to one or more of the following:

- lack of clear jurisdiction;
- a narrow, fragmented approach to planning, in which projects are considered in isolation from the rest of the shore;
- failure to consider cumulative effects;
- failure to understand or consider coastal processes;
- lack of marine engineering codes, monitoring, and enforcement;
- lack of effective fill quality control (although this has improved more recently);
- lack of information on the relation of contaminated fill to the aquatic food chain; and
- failure to apply an ecosystem approach to planning the shoreline.

The Greater Toronto Bioregion (GTB) shoreline is subject to great and growing pressures as the result of intense urban and industrial development. The prospect of a million additional residents, crowded near the lake, looking for work, transportation, and recreation, presents both threats and opportunities. That is why the need for shoreline protection and regeneration is greatest in the GTB.

The complexity of multiple jurisdictions is an obstacle. There is reason for optimism however, based on the progress achieved with similar problems by the San Francisco Bay Conservation and Development Commission, and the Fraser River Estuary Management Program in the Vancouver area.

Lakefilling and other forms of shoreline modification will be damaging if they are carried out in future in the same way as in the past. However, there are better ways to plan and control future developments that will eliminate some projects and restrict others, but ensure that those approved are of obvious public benefit. Such an approach is described in the report, which follows the summary of key recommendations.

Key Recommendations

No single catastrophic mistake caused the degradation of the shore environment. Rather, a piecemeal approach to the shore is its root cause. Each project was considered in isolation from the ecosystem, and cumulative effects of many small injuries has bruised the whole shore. Correction can come only

from a co-ordinated, planned approach based on the conviction that the benefits of regeneration will far exceed the effort expended.

Recommendation

The governments of Canada and Ontario should adopt as a goal the regeneration of the shoreline of the Greater Toronto Bioregion, based on an ecosystem approach and emphasizing:

- **protection of remaining natural areas;**
- **rehabilitation of degraded areas; and**
- **consideration of cumulative effects in future shoreline development proposals.**

Recommendation

In order to achieve this goal, the governments of Canada and Ontario, in consultation with municipalities, regions, relevant agencies, and the public, should develop an integrated plan for the GTB shoreline.

Recommendation

All new projects should be subject to the proposed integrated shoreline plan for the Greater Toronto Bioregion. It would assess the carrying capacity of the shore for additional lakefill projects and, should these be acceptable, would designate the most beneficial locations; exceptions would be by plan amendment.

Recommendation

Siting and design of any new facilities should take into consideration coastal dynamics, habitat enhancement, by-passing of sand if appropriate, embayments, the potential for concentration of contaminated sediments, and the proper dispersion of effluent from rivers and outfalls. Such projects should be subject to environmental assessment, including assessment of cumulative effects.

Recommendation

An effective mechanism should be put in place to monitor and control major projects; sanctions should be applied when the completed project does not correspond to what was promised, especially in respect to public amenities.

Recommendation

Private facilities using lakefill structures should pay an appropriate share of capital and maintenance costs to ensure that demand is not artificially stimulated by subsidy and taxpayers are not offended by the use of their money for private benefit.

Having reviewed evidence that heavy metals from contaminated lakefill material enter the food chain, it is clear that only clean material should be dumped in the lake. Implementation of the more stringent *Provincial Sediment quality Guidelines: Draft* will exclude material that would have harmful effects when dispersed in water. A direct consequence would be a large quantity of material requiring land disposal. Most of this slightly contaminated soil does not need the control afforded by sanitary landfill sites, which are in short supply.

Recommendation

The Work Group recommends that Regulation 309 of the Environmental Protection Act be amended to create a new "restricted fill" waste category for excavated soil unsuitable for open water disposal, but not requiring the control of sanitary landfill.

It is possible that such material could be safely disposed of in disused pits and quarries or artificial hills or berms with recreational, commercial or aesthetic benefits. A substantial opportunity exists to employ large volumes of material diverted for lakefill to cover and raise the elevation of industrial land subject to redevelopment in the City of Toronto. It is essential, however, that the environmental consequences be carefully evaluated in each case.

Recommendation

The Group further recommends that a new system be developed by MOE to govern excavation of potentially contaminated soils. All excavation projects beyond 100 tonnes (110 tons) would have to be approved by the Ministry of the Environment. As part of the approval process, a decision would have to be made on managing soil, with priority given to re-use and recycling for clean soils. Soils too contaminated for open water disposal would be sent to land disposal sites, based on the new restricted fill classification set out above.

Once the safe standards for material acceptable for open water disposal have been established and appropriate disposal sites identified, a system is needed to ensure that the fill delivered actually meets the standards set for it.

Recommendation

Administration of the Improved Lakefill Quality Control Program should be transferred from MTRCA to MOE, which should be granted the resources necessary to carry out the program. A Certificate of Approval should be required for all major lakefills, under the Environmental Protection Act.

Key elements in the regeneration of the shoreline are the protection and restoration of both terrestrial and aquatic habitat.

Recommendation

The GTB Shoreline Plan should include explicit goals and objectives to protect existing habitat, restore what has been degraded, and enhance habitat for native species.

Recommendation

The Provincial Draft Wetland Policy Statement should be adopted under Section 3 of the Planning Act.

Recommendation

Existing legislation should be enforced vigorously as a means of protecting the remaining natural areas as an interim holding measure pending development of the plan.

Recommendation

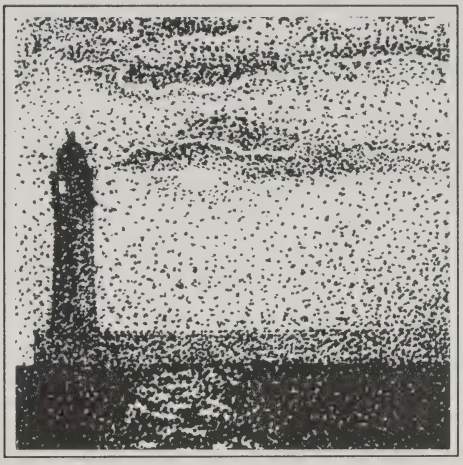
Protection and creation of natural areas and habitat, particularly in urban and near-urban settings, should be given priority in the GTB Shoreline Plan, and in plans for the connected watersheds.

There are many possible approaches to implementation of the Plan, including: new legislation, legislative amendments, policy statements and declarations of interest, and co-operative agreements similar to the Fraser River Estuary Management Plan. Regardless of the approach taken, flexibility and creativity will be needed in creating the tools employed to implement the plan in the context of many competing interests within each community. Partnership agreements between governments and the Land Regeneration Trust to acquire and rehabilitate land could prove to be valuable.

Common to all the approaches to plan development are two requirements:

- leadership by the two senior levels of government in development and implementation;
- public involvement at each stage to obtain input, and to achieve understanding, acceptance, and support for the goals, objectives, and constraints of the plan.

Clearly, development and implementation of this plan will be a complex and challenging task. The reward for success will be a healthier waterfront offering affordable recreation; scenic beauty; employment; culture; drinkable, swimmable water; edible fish; and a shoreline at the doorstep of millions that will be a matter of pleasure and pride for them. What better use could there be for our talents than to create such a gift for our grandchildren?



INTRODUCTION

The Royal Commission on the Future of the Toronto Waterfront was created in 1988 by the Government of Canada to examine Toronto waterfront issues in a broad context. In 1989, in response to a request from the Government of Ontario, the Commission's mandate was expanded to the Greater Toronto Bioregion (GTB) including the shoreline from Burlington to Newcastle. The Commission, under the Honourable David Crombie, has published two interim reports. The second, *Watershed,* which was published in August 1990, made 80 recommendations based on an ecosystem approach. Two recommendations addressed shoreline modifications directly:

> The Province should bring forward comprehensive lakefill policies for public review as soon as possible. The policies should require thorough environmental appraisal of all individual lakefill projects, and of their cumulative effects, across the Greater Toronto Waterfront. Until such policies are in place, there should be a moratorium on new lakefilling.
>
> Open water disposal guidelines should be adopted for current lakefill projects. (Royal Commission on the Future of the Toronto Waterfront, *Watershed,* 1990, 98)

On 17 December 1990, the Minister of the Environment rose in the Legislature and said that she had asked the Royal Commission to address "... policies, practices, technology, and methods available to regenerate shoreline areas." In response, the Commission established the Shoreline Regeneration Work Group to prepare information and options, as a basis for public hearings to be held in 1991.

The Shoreline Regeneration Work Group

Definitions

For the purposes of this report, the shoreline consists of the littoral zone — the lake to a depth of approximately 10 metres (33 feet) including estuaries and related marshes, and inland to include beaches, and bluffs, and nearshore areas.

Regeneration is defined as comprising the policies, practices, and technologies needed to restore the waterfront so that it is "clean, green, useable, diverse, open, accessible, connected, affordable, and attractive," in keeping with the principles of the Royal Commission. There is no intention of recreating some romantic concept of the 17th century forest primeval. Instead, the goal is a healthier, more resilient, and diverse environment.

The following is a synopsis of the nine principles that, collectively, make up regeneration and are discussed at length in Chapter 2 of *Watershed.*

Clean

Air, land, sediments, and water should be free of contaminants that impair beneficial use by people and other living beings.

Water should be of a quality that allows fish to be eaten without restrictions caused by the presence of contaminants, and people to swim and play water sports without risk of illness; levels of potentially toxic chemicals in drinking water should remain below detectable limits or meet all accepted health standards.

Green

The diversity and productivity of ecological communities should be protected and restored through measures to preserve the genetic diversity of indigenous plants and animals; restore healthy natural habitats and communities; and maintain natural ecological processes.

Natural vegetation should be used where feasible, to restore and enhance the attractiveness, health, and useability of human communities.

Useable

Among other applications, the waterfront should continue to support a mix of public and private uses that are primarily water-related, and permit public access, use, and enjoyment of the water's edge.

Diverse

The waterfront should provide diverse experiences for visitors and residents, using a mix of open space and recreation facilities that balances public demands with environmental limits.

Open

The density and design of waterfront structures should not create a visual barrier or be an intrusion on the water's edge, which should be identified clearly as open to public access.

Accessible

All waterfront activity nodes and communities should be accessible by public transit as well as by road, with increasing emphasis on transit; they should also be accessible by foot or bicycle.

The waterfront should be safe, and accessible to the disabled as well as to all other segments of society.

Connected

Major green corridors should connect the waterfront, valley systems, and the Oak Ridges Moraine; the waterfront should be joined by pedestrian and bicycle trails from Burlington to Newcastle. Links with the past should be retained as well.

Affordable

Parks and facilities on the waterfront should be financially available to all income groups, and waterfront residential projects should include affordable housing.

Attractive

Waterfront design should consider vistas and views of the lake, sensitive design of buildings, open spaces, microclimates, useable links, harmonious colours and textures, and natural as well as manicured landscape techniques.

Regenerating the shoreline involves many programs operated by both provincial and federal agencies. The impact of offshore, airborne, upstream, and other inland pollution is great: indeed, success in reducing the flow of toxics emerging from the Niagara River and effluent from the sewage treatment plants, storm sewers, and combined sewers is essential to regenerating the waterfront.

The Work Group recognizes that programs to deal with upstream problems are important, but considers them beyond its mandate. Instead, the Group concentrated on matters closely related to shoreline modification such as lakefilling and erosion control, and their effects on achieving the goal of regeneration.

Mandate

Taking as its area of study the shore of Lake Ontario from Burlington to Newcastle — the shore of the Greater Toronto Bioregion, as shown in Figure 1 (see fold-out map) — the Work Group met for the first time on 4 February 1991; its mandate was to produce a document that would:

- summarize current conditions, laws, policies, and regulations;
- identify relevant issues and concerns;
- outline opportunities for regeneration; and
- develop and explore policy options.

Members

The Work Group comprised people from diverse backgrounds, each with expertise and experience, in order to give this report the benefit of different viewpoints; these included science, engineering, economics, law, and planning. Brief biographies of the members appear at the beginning of this report.

The Work Group sought to produce a practical analysis of the issues and options, expressed clearly, and understandable to the interested reader. This document should assist interested groups and the Commission in its deliberations.

Process

A great deal of information was available, including useful testimony given to the Commission during public hearings concerning its earlier reports. In addition, the Work Group, through the auspices of the Commission, contracted with the Lake Michigan Federation, a citizens' group based in Chicago, to prepare an analysis of federal, state, and local laws and regulations in the United States.

This and many other relevant documents have been deposited with the Canadian Waterfront Resource Centre, currently located at the Commission's Toronto office, a lasting store of knowledge for use by the public and researchers after the Commission completes its work.

Each member of the Work Group conducted research, consulted amongst his or her professional colleagues, and discussed issues and options in the Group and with outside experts.

Sustainable Environment

In his book, *Entrusted to My Care*, Grant MacEwan points out a fallacy in society's attitudes and methods of dealing with natural resources. Planning and development activities have focused on creating new infrastructure and facilities for human use and enjoyment. The underlying attitude that dominates these activities is that the world was created primarily to serve our needs. MacEwan described our place in the scheme of things:

> It is wrong to suppose the world was created primarily to serve mankind's purposes and pleasures. A conviction about having dominion over land and water and living things breeds ideas of unwarranted self importance. It is a sobering thought that man's place in Nature's scheme is, after all, a small one. (J.G. MacEwan, *Entrusted to My Care*, 1966, 2)

In approaching shoreline regeneration, it follows naturally that — as one of the species that inhabit the earth and are totally dependent on the productivity and health of the natural environment — human beings should favour policies,

plans, and designs based on the concept of sustainable environment.

Regeneration in Tommy Thompson Park

While sustainable development is concerned with the satisfaction of human needs and aspirations, the concept of "sustainable environment" deals with maintaining the health of the natural environment as the first priority. A sustainable environment can be defined as one in which natural systems are protected, maintained, and enhanced, to ensure that they remain biologically productive, regenerated, and healthy.

Applied to a shoreline ecosystem, this means that ecological needs must be a basis for evaluating development proposals. Consideration of species diversity, habitat area and productivity, open space corridors, wildlife populations, and management should have a major influence on shoreline regeneration plans. In the past, lakefill development has taken place primarily on the basis of considerations related to access, recreation, waste disposal, and shoreline protection requirements, with little attention to sustaining the natural environment.

Some lakefill benefited the natural environment, but too often these changes were accidental. When Tommy Thompson Park was colonized by plants and birds, a wasteland became a productive wild area inhabited by many species, some uncommon or rare. New plant and animal habitats emerged, and demonstrated the fecundity of nature, a reminder that our place on the planet is incidental: if we disappear, the remaining plant and animal species would close ranks, and get along quite well.

Ecosystem Approach and Cumulative Effects

The ecosystem approach has been discussed in previous publications of the Royal Commission on the Future of the Toronto Waterfront, including *Watershed* and *Pathways*. The latter describes a desirable ecosystem approach as:

- using a broad definition of the environment: natural, physical, social, cultural, and economic;
- focusing on links and relationships among air, land, water, and living organisms, including humans;

- recognizing the dynamic nature of ecosystem processes;
- understanding that humans are part of nature, not separate from it;
- emphasizing the importance of living species other than humans, and of future generations;
- incorporating the concepts of carrying capacity, resilience, and sustainability;
- working to restore and maintain the integrity, quality, productivity, dignity, and well-being of the ecosystem. (Royal Commission on the Future of the Toronto Waterfront, *Pathways,* 1991, 37)

Watershed identifies means to achieve the Commission's goals, using an ecosystem approach. This rational approach to connections in the environment both provides an explanation for some past failures and suggests a better way for handling waterfront development in the future.

In response to the report, the Honourable Ruth Grier, Ontario Minister of the Environment, said:

> ... our clear acceptance of Mr. Crombie's principles should be viewed by municipalities and the community as a ringing endorsement of the ecosystem approach to planning as well as to the underlying values of the Commission report.

An ecosystem approach means that development projects that treat the environment as an afterthought can expect a rough ride — the old priorities are reversed. Nevertheless, several large plans have been put forward that include development proposals that depend on lakefill, such as the Etobicoke motel strip development and Mississauga's *Vision 2020.* At the same time, the construction industry is demanding practical, predictable alternative disposal sites for excavation waste, and dump trucks circling the Legislature have a marvellous way of attracting the media and concentrating the minds of politicians.

These pressures are being applied at a time when governments lack a clear policy framework within which to shape a coherent response, and shoreline regeneration has become a significant issue.

Wherever practical, the Work Group, aware that many past errors in shoreline development arose from a narrow viewpoint, adopted an ecosystem approach.

For example, instead of looking at how to create spawning beds for lake trout for the sport fishery, we considered the whole food web that supports those large predators, including the organisms that inhabit the waterfront sediments, the sources of contamination of these creatures, and the steps needed to reduce the causes of turbid water and contaminated sediment.

Similarly, instead of focusing on the remediation of sediments caught in marina embayments, the whole question of creating embayments was addressed.

Finally, the goal of diversity and overall health of the ecosystem was in the forefront of all the Work Group's discussions.

It became evident that many of the larger problems along the waterfront were not the result of one horrendous event but, rather, the cumulative effect of a large number of acts or interventions. Treating each project in isolation from the rest of the shore was a common cause of significant degradation.

An example of cumulative effects can be found in the destruction of the Ontario lake trout fishery. Many factors — including loss of habitat, pollution, overfishing, and the ravages of the alien lamprey eel — reduced the fishery from 90 tonnes (99 tons) in 1940 to five tonnes (six tons) in 1950. Lake trout virtually disappeared and, although lamprey populations are now under control, have not returned, probably because siltation and prior removal of shoreline stone destroyed the sheltered rocky breeding waters that are the species' habitat. No one event caused the loss of this important commercial activity and source of fresh food: it was the effect of a series of decisions and events.

Because it is necessary to understand the impact of cumulative effects in assessing the potential impact of future policies and initiatives, the Work Group sought ways to apply the concept to beneficial planning and management of the shoreline. Cumulative effects are a measure of the combined impact of all stresses in an area over time, as well as the incremental impact of new stresses associated with individual projects. Accounting for them involves two basic components: first, a holistic understanding of the environmental conditions in the area being studied; second, an assessment of how these conditions have changed or are likely to change, given alternative scenarios.

Values and Outlook

Two value systems sometimes conflict during environmental discussions. The anthropocentric, or human-centred, view assesses everything in terms of its impact on humans, while the universal view values the entire biosphere and seeks protection of all components without regard for their apparent direct benefit to humans. Early in its deliberations, the Work Group agreed that both approaches had merit, and the conclusions were similar, regardless of the philosophical starting point. Any apparent emphasis on human benefits in the following comments is not intended to discount equally valid concern for the biosphere.

The Work Group rejects the suggestion that it is necessary to trade off a healthy environment for a strong economy; rather, we take the position of the Commission of the European Communities:

> This conflict between environment and economy is ... a false one since in the long term the protection of environmental resources is a basic condition for sustained economic growth, which can itself contribute to environmental improvement. (Commission of the European Communities, *Green Paper on the Urban Environment*, 1990, 33)

By emphasizing environmental sensitivity and responsibility, we believe that, ultimately, there will be as many or more economic benefits for the province.

The Work Group found that environmental damage caused by shoreline modification is significant, but is modest compared with the flood of contaminants and pollution entering the lake from other sources such as the Niagara River, or the sewage treatment plants. We were encouraged, however, by the progress made in reducing phosphates, and a few other contaminants.

Consequently, we took the optimistic view that existing and future planning and regulatory initiatives would effectively deal with those who are principally responsible for degrading the lake environment. Without that assumption of progress in dealing with the major upstream sources, achievements at the shoreline would likely be overwhelmed, and the goal of regeneration beyond our grasp. Given the apparent economic and recreational benefits that regeneration offers to millions of people, we assumed the leadership and resources would be found, and therefore we proceeded to address the opportunities for restoring the health of the shoreline.

Why Is Shoreline Regeneration an Issue Now?

Concern for the earth has been of growing importance since the 1960s, when Rachel Carson's *Silent Spring* drew attention to the hazards of poisons in the biosphere, and beautiful images of our frail planet were transmitted from the moon. This changing attitude is expressed in many ways, such as the warm reception given to the report of the World Commission on Environment and Development (the Brundtland report), released in 1987, which offered the concept of "environmentally sustainable economic development." It is also evident in the renewed interest in recycling, and slogans like "think globally, act locally."

In 1967, when the last Metropolitan Waterfront Plan was presented, times were simpler and few questions were asked of grand schemes. Large civil engineering projects were viewed as signs of vitality; the answer to pollution was dilution; the threat of toxic chemicals was dimly perceived; and Lake Ontario was a boundless bowl to flush away the excretions of a bustling metropolis.

In the 1990s, people have a very different attitude to shoreline modification. There is a wariness, a determination to question whether each project can be

examined in isolation from the rest of the shore, or whether the negative impact on the environment can be engineered away. The possibility of water contamination from lakefilling projects is considered in the context of a profound concern for the quality of drinking and bathing water, and the health of the natural environment.

Deformed bill on double-crested cormorant

Experience has brought a measure of wisdom and understanding, and a hint of humility. The public of today no longer takes its drinking water for granted. The sight of birds with deformed beaks, and the recognition of an ever-expanding list of carcinogenic compounds in our environment, have made us more cautious — one reason that bottled water and high-technology filters are enjoying unprecedented sales.

Increasing urbanization brings with it the longing for the restful, the green, and the natural. More and more, the idea that an urban waterfront must be dirty, ugly, dangerous, and polluted, or that urban parks must be manicured, artificial, and sterile, is being challenged.

Ontario's urban dwellers love to be near water, particularly in the summer months. Some of those who have a northern cottage have found that the stresses of driving on a summer weekend negate the reason for the trip. Those who remain in the city are learning to enjoy the lakeshore close at hand. Cherry Beach, Ontario Place concerts, Toronto Islands picnics, and walking in the urban wilderness along the Leslie Street Spit offer pleasing possibilities at our doorstep.

It is not surprising, therefore, that the Royal Commission's concept of the waterfront, as delineated in *Watershed* — that it should be clean, green, accessible, and attractive — has struck a resonant cord with people searching for rest and recreation close to home. This desire drives certain kinds of development, and those concerned about preservation and water quality apply another set of pressures. The high level of interest, concern, and changing values are the reasons shoreline regeneration is an issue today.

Guide to the Report

This report comprises an introduction and five chapters preceded by an Executive Summary that gives the reader a condensed and simplified explanation of the key findings and recommendations.

The introduction explains the origin of the study, provides key definitions, and describes the review process. The authors have tried to minimize the use of technical terms, but some are impossible to avoid, which is why a glossary has been included at the end of this report.

Chapter 1 describes the evolution of the Greater Toronto Bioregion shoreline and its current condition, while Chapter 2 deals, in five sections, with the issues related to shoreline regeneration. Chapter 3 explains the applicable jurisdiction, legislation, and planning processes applicable to the GTB shoreline; it evaluates and compares them with other provinces and states in the U.S. Great Lakes Region. Chapter 4 responds to issues raised previously, and Chapter 5 introduces some possible approaches to implementing the recommended approach, including various means to advance towards the goal of shoreline regeneration.

CHAPTER 1

HISTORY OF THE SHORELINE

The continuous action of wind, wave, frost, and ice since the retreat of the glaciers 15,000 years ago has constantly altered the shoreline of Lake Ontario. For example, waves pounding against a prominent headland on the central north shore, now called the Scarborough Bluffs, eroded vast quantities of glacial sediment. Boulders and gravel were deposited on the lakebed, while sand-sized particles were moved west by the waves to form a long spit of land that evolved to become the Toronto Islands. Seeds washed ashore, and the resultant plant life consolidated the wave-washed beaches. Insects, birds, and animals made their way to the new ground and a vibrant living peninsula emerged from the shore. An extensive marsh habitat developed behind the shallow easterly portion of the peninsula, where aquatic life flourished in a complex community of plants, fish, birds, and animals.

The pattern of erosion and deposition was the creative force behind the evolving form of the shoreline. The energy that powered the changes is derived from the dynamic effect of wind and water, referred to as coastal processes.

Coastal processes are the means by which water and sediment move in the nearshore zone. In the Great Lakes, they are determined by the waves created by the winds. The power of the waves is determined by the wind strength, duration, and fetch — that is, the open water distance exposed to the wind. An east wind has a fetch of 257 kilometres (160 miles) before reaching Toronto; consequently, storm waves from that direction build up a lot of energy, most of which must be released as the waves enter the nearshore zone, and then break (see Figure 2).

The more energy in the breaking waves, the larger the particles that can be moved. The finest of sediments are actually suspended in the water, and can be transported by even weak lake current. Silt and sand-sized particles roll and bounce along the bottom in the direction of the waves. This littoral transport depends on wave direction and energy to transfer material from areas of erosion, like the Scarborough Bluffs, to areas of deposition such as the beaches near Woodbine Avenue.

A second source of material is discharged from the rivers and streams that deliver eroded material from upstream banks and fields exposed by development or farming. Some is transported offshore to be deposited in deep water zones, while the rest moves along the shore until it encounters an area of low

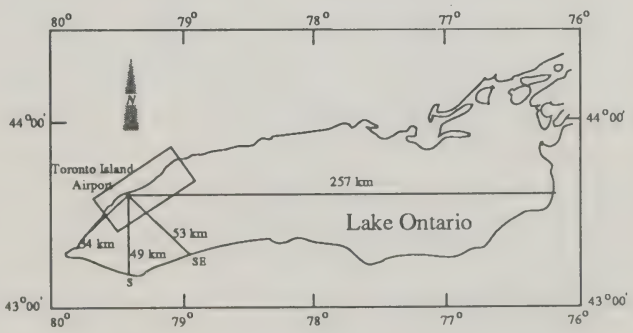


Figure 2. Fetch lengths to Toronto's central waterfront

wave energy, such as an embayment, where it settles and accumulates. It should be noted that areas of erosion and deposition will change with the wind strength and direction. Easterly winds are not the most frequent, but the great energy built up in them over the long fetch causes the net westward movement of material. Whitby is the nodal point separating net westward and eastward littoral drift.

The dominant feature of the Lake Ontario shoreline east of the Don River is the eroding bluffs of glacial till, a mixture of boulders, gravel, sand, silt, and clay left by the glaciers. Material is released from the bluffs as moisture in the subsoil freezes and thaws during the spring and fall; by wave action eroding the toe of the slope below the water line; and by waves directly attacking the steep bluff walls.

West of Whitby, the littoral drift moves by wave action predominantly to the west, and historically was deposited at or near the Toronto Islands. The shoreline west of Toronto is made up principally of shales that erode more slowly than the glacial tills and supply less material for littoral transport. Net direction of transport for that material, supplied mainly by tributary streams, is west towards the Hamilton beach strip, also known as the Burlington Bar, the next depositional feature.

The overall pattern of movement defines the "littoral cell" for the greater Toronto region. Within this broad unit, various features, both natural and artifi-

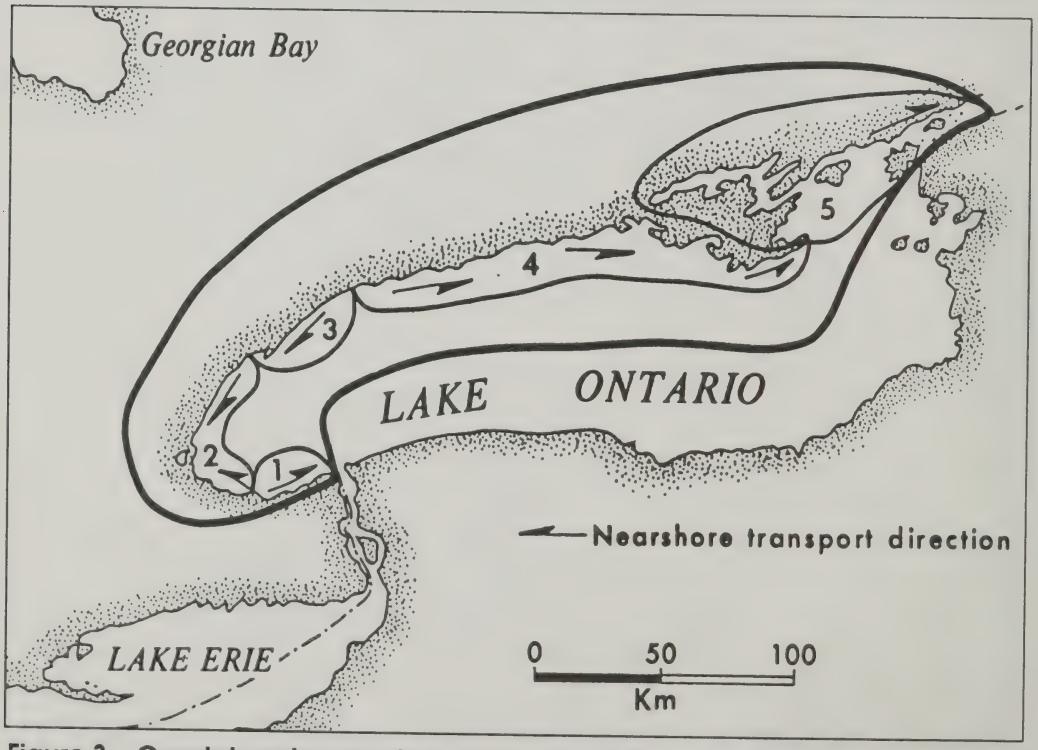


Figure 3. Coastal environments and shore zone transport direction in the Lake Ontario region

cial, have created sub-cells or "compartments", such as the erosion east of Bluffer's Park in Scarborough, and deposition on the beaches next to Ashbridge's Bay.

In sheltered areas, such as Toronto's Inner Harbour, there is not enough wave energy to move sediment very far; as a result, sediment in the Don River is quickly deposited and obstructs the discharge from the rivermouth. That is why it is necessary to dredge various channels periodically.

Early Settlement and the 19th Century

The most dramatic creation by coastal processes on the north shore of Lake Ontario was the peninsula, islands and marshes extending west from the mouth of the Don River. Native people and later, European immigrants sheltered in the natural harbour, in the lee of the peninsula that became the Toronto Islands. There was an abundance of food available in the fish and wildlife from the various aquatic and terrestrial habitats nearby, including cold freshwater, nearshore rocky reefs, warm freshwater shore marshes, estuaries, rivers, streams, pools and wetlands, beaches and bluffs, thickets, meadows, and forests in various stages of maturity.

Lake Ontario and its tributary streams supported at least 50 species of fish, including Atlantic salmon, lake trout, whitefish, and herring. Two hundred and seventy-eight species of birds and a wide variety of animals were regular inhabitants, among them beaver, marten, otter, lynx, elk, timber wolf, black bear, and wolverine.

The new settlers believed that fish and wildlife were inexhaustible and that it was more important to develop the harbour for commerce than to worry about natural habitat.

A young engineer, Sandford Fleming (later Sir Sandford Fleming), said:

> ... therefore, must we ascribe the beginning of Toronto to the unequalled excellence of this harbour forming on the north shore of Lake Ontario, the most facile outlet for the production of the back country, is principally due to the rapid and uninterrupted progress in commerce and wealth of the western capital. (Sandford Fleming, *Report on the Preservation and Improvement of Toronto Harbour*, 1854, 15)

The 1793 plan of York Harbour showed a long narrow sand peninsula widening to about 1,600 metres (one mile) at its western end. The western harbour entrance, which had measured 500 metres (550 yards), was reduced by sand deposition to 70 metres (77 yards) by 1854. The natural forces that had created the wonderful harbour continually changed its shape and depth, a phenomenon that distressed the harbour officials so much they purchased a dredge

to keep the gap open, and requested reports on the best way to "preserve and improve Toronto Harbour".

The distinguished engineer and Provincial Surveyor, Kivas Tully, responded:

> According to the old saying, "prevention is better than cure" if the true remedy requires to be pointed out; and admitting that the continued deposit on the Peninsula [Toronto Islands] is caused by the "debris" from the Scarboro' heights, expend the money that would be wasted on the construction of piers and groynes, in the protection of the base of Scarboro' heights and the object is obtained; **but the wisdom of this course is to be doubted** [emphasis added] ... a considerable portion of the deposit on the Peninsula is removed by the undercurrent not to be replaced, except by this very supply from the Scarboro' heights which is considered so great a nuisance ... taking all matters into consideration, this supply, on the contrary, will, on reflection, be considered advantageous in preserving the Peninsula, and consequently preserving the Harbour. (Kivas Tully, *Report on the Means to be Adopted for the Preservation and Improvement of Toronto Harbour*, 1854, 33)

The conflict apparent in these observations by Tully is both a credit to his insight and an example of the dilemma that bedevils all those would "improve" a portion of the shore. The dynamics of the physical system were only partially understood; each action had consequences elsewhere; and results were uncertain.

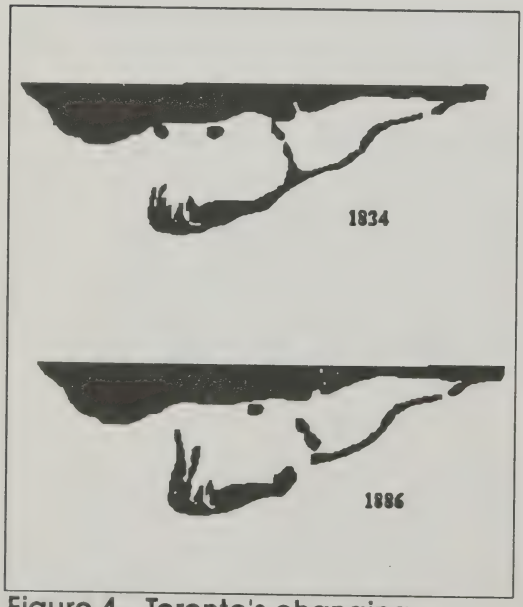


Figure 4. Toronto's changing central waterfront shoreline

In 1858, a storm created a 160-metre (175-yard) opening in the peninsula, near the present Eastern Gap. By 1882, it was 1,500 metres (1,640 yards) wide and people were concerned about the very existence of the natural harbour. Extensive modifications including the construction of dikes, breakwaters, seawalls, piers, groynes, dredging, and lake-filling were initiated, activities that continue to this day.

East and west of Toronto, settlements were established near river estuaries that could be exploited as sheltered harbours. Some — like Oshawa, Whitby, and Port Credit — prospered while those on small

creeks choked on deposits of the heavy silt that resulted from the erosion of adjacent lands cleared for farming. Development of the ports drastically reduced the rivermouth wetlands and, combined with the disappearance of forests as farms were established along the waterfront, dramatically diminished habitat. River temperatures and volumes became subject to greater fluctuation; turbidity and siltation increased, thereby covering spawning beds and disrupting fish migration.

During the 19th century, there was a boom in construction industry along the Lake Ontario shoreline: builders from Burlington to Whitby utilized stone from the bottom of the lake, and sand from its beaches. Working from wooden schooners, "stone hookers" — men wielding poles like sturdy pitch forks with the tines bent at right angles — probed the clear water to loosen and lift stones from the bottom. The stone hookers (the name was applied to the schooners as well as to the labourers) removed as much as 43,000 tonnes (47,000 tons) a year during the 1840s. (L. Joyce, *At the Mouth of the Credit,* 1988, 38)

Unfortunately, the stones were important to the relative stability of the shore because they armoured the lakebed and lessened erosion. They also provided spawning and feeding grounds for certain species of fish, such as lake trout. Accelerated shoreline erosion was so noticeable that farmers complained about loss of their shoreline property and, in 1857, the "Three Rod Law" was passed, prohibiting removal of stone within 15 metres (50 feet) of the shore. This proved to be "too little, too late": serious damage had already been done.

Changes on the Shoreline, 20th Century

The Port of Toronto

The best natural harbour on the north shore of Lake Ontario determined the location of the settlement that became Toronto. In 1911, the Board of Toronto Harbour Commissioners (THC) was created by an act of the federal Parliament.

The harbour continued to generate commercial activity over the next 60 years. A desire for much increased shipping and industry, as well as parkland and summer residences, led to the THC's 1912 Waterfront Plan. Between 1914 and 1930, approximately 428 hectares (1,057 acres) of Ashbridge's Bay wetlands were filled to create industrial land, in accordance with that plan. The fill material was primarily sediment dredged from the Inner Harbour, but included construction debris, excavated soil, sewage sludge, incinerator refuse, and municipal garbage.

In the 1950s, in order to create additional harbour facilities the THC initiated a new lakefill project at the foot of Leslie Street that utilized earth fill, rubble, incinerator and fly ash, and crushed battery casings. Instead of conven-

Garbage dump at Toronto waterfront, 1922

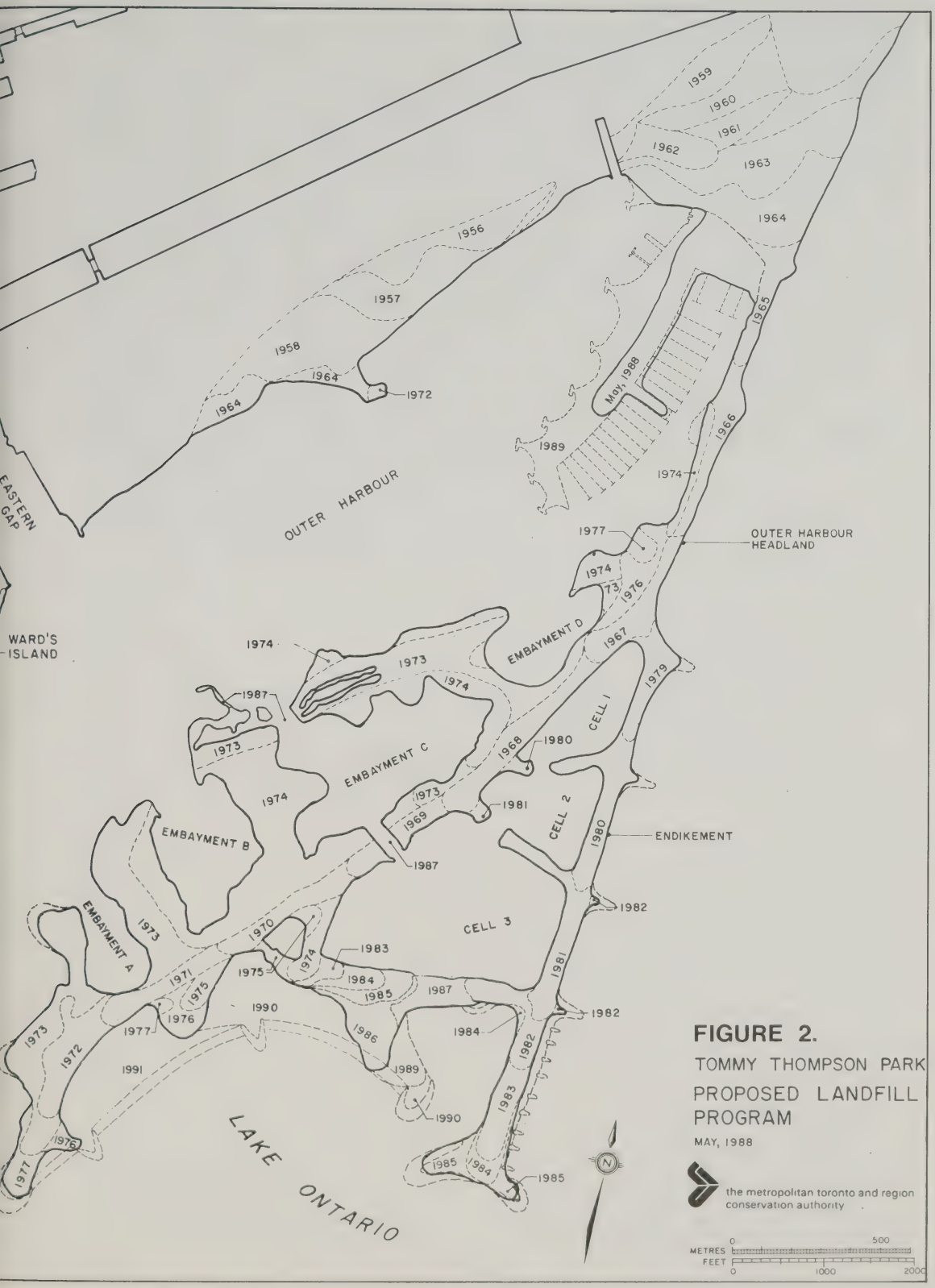
tional filling within armoured enclosures, the material was deposited in the exposed waters of Lake Ontario, without protective works to prevent erosion of the fresh fill.

By the 1960s, most of the components of the THC's 1912 Waterfront Plan were in place, and a new plan to expand waterfront development was conceived. The result was the 1967 Waterfront Plan for the Metropolitan Toronto Planning Area. It called for massive lakefilling and had the following goals: to achieve a continuous belt of public open space; public marinas for 5,000 new boat slips; a protected waterway behind a semi-continuous chain of islands with camping sites; and a waterfront scenic drive.

The 1967 Plan recommended that the lake continue to be used as a site for the disposition of surplus fill from building sites and public works, and went on to include the use of fly ash, solid industrial wastes, dredged silt, demolition wastes, municipal garbage, rubbish, incinerator residues, and digested sewage sludge as fill material. It took the position that water temperature in Lake Ontario precluded swimming, and recommended that several artificial lakes be constructed for recreational purposes. The only other water quality problem it foresaw was the need to chemically or mechanically remove nuisance algae growths from the new lagoons. No consideration was given to protecting the existing aquatic habitat.

The fill project started at the foot of Leslie progressed and by the early 1970s a narrow neck of land extended some three kilometres (two miles) into the lake in a southwesterly direction. In the mid-1970s a major expansion of the Leslie Street Spit was created by dredging eight million cubic metres (10

Figure 5. Map of Tommy Thompson Park lakefill project



million cubic yards) of littoral sands from the intended Outer Harbour. The Leslie Street Spit remains the most active lakefill site in the Greater Toronto Bioregion, offering convenient disposal facilities for earth and rubble from development in the downtown Toronto core.

The most recent lakefilling at the site has been directed at refilling the area dredged in the mid-1970s in order to provide the land base for a marina to accommodate the increased recreational boating that has offset the decline in commercial shipping activity.

While the THC was building the Leslie Street Spit, it provided design and construction services to the Metropolitan Toronto and Region Conservation Authority (MTRCA) for a series of lakefill projects, at the mouth of Mimico Creek, in Ashbridge's Bay, and in Bluffer's Park at the foot of Brimley Road.

These three sites were the first of a new breed of recreational lakefill projects envisaged in the 1967 Waterfront Plan, expanded by MTRCA, and adopted with varying degrees of success by other conservation authorities along western Lake Ontario. The idea was that parkland could be created at less cost than purchasing existing land. All the artificial headlands have been configured to accommodate marinas and/or boat clubs; MTRCA considered them to be preferable to traditional marina development in the environmentally sensitive estuaries of rivers and streams.

Table 1. Major lakefill projects in the Greater Toronto Bioregion

Project	Area	
	(hectares)	(acres)
J.C. Saddington Park	10	24
Lakefront Promenade Park	30	74
Colonel Samuel Smith Waterfront Area	28.5	70
Humber Bay Park-East and West	40	99
Ontario Place	38	94
Tommy Thompson Park (land and water)	470	1,161
Ashbridge's Bay	17	42
Bluffer's Park	42	104

Source: Royal Commission on the Future of the Toronto Waterfront, *A Green Strategy for the Greater Toronto Waterfront*, 1990.

Eight major projects have either been completed or are under construction in the study area.

Since 1950, approximately 676 hectares (1,668 acres) of land have been created through lakefill and a significant number of new projects have been proposed that could add 1,000 hectares (2,471 acres) of lakefill land. These projects and their proposed size are shown on Figure 1 (foldout map). Clearly the creation of this land has been and is a very large real estate undertaking, with substantial implications for land use, material disposal, physical development, capital, operating costs, and revenues.

It is generally agreed that the artificial headlands interrupted the passage of sand in the littoral zone and caused accumulation on the updrift side and, possibly, accelerated erosion on the downdrift side. Cooling water entrance groynes at the Pickering Generating Station and the Bluffer's Park lakefill impeded littoral transport. The Leslie Street Spit cut off resupply of the Toronto Islands, and much of the supply of sand to Toronto's Eastern Beaches is now threatened by extensive shore protection works being undertaken by MTRCA at the base of the Bluffer's Park.

Water and Sediment Quality

Measuring the chemical, physical, and biological characteristics of water and sediment quality is one way to monitor pollution. Relatively little historical information is available on water quality, because few comprehensive studies were conducted in Lake Ontario prior to 1960. The studies that do exist are of Lake Ontario samples taken outside the GTB shoreline, and they deal primarily with total dissolved solids or with bacterial levels originating from raw sewage. Other sources of information on past conditions include fishery statistics and water quality data from municipal water intakes.

Data on the Toronto Islands Filtration Plant intake water show little change between 1923 and 1964 in the mean annual pH, total alkalinity, and hardness,whereas chloride values, reflecting increased use of road salt, doubled linearly throughout the lake. Ammonia and turbidity increased substantially during the same period. Free ammonia doubled, and reached levels higher than those recorded elsewhere in Lake Ontario, an effect attributed to local pollution from raw sewage. Turbidity — that is, cloudiness of the water caused by suspended sediment and algae — virtually tripled between 1923 and 1964, reflecting the degree of urban pollution in the Toronto area.

The distribution of nearshore bottom sediment type in 1968 (prior to most lakefill development) is shown in Figure 6. A deposit of littoral sand in the Toronto Islands area thinned out to the east of Metro to become exposed glacial till with outcrops of boulders and areas of bedrock. Humber Bay and the Toronto Inner Harbour provide sheltered environments for the accumula-

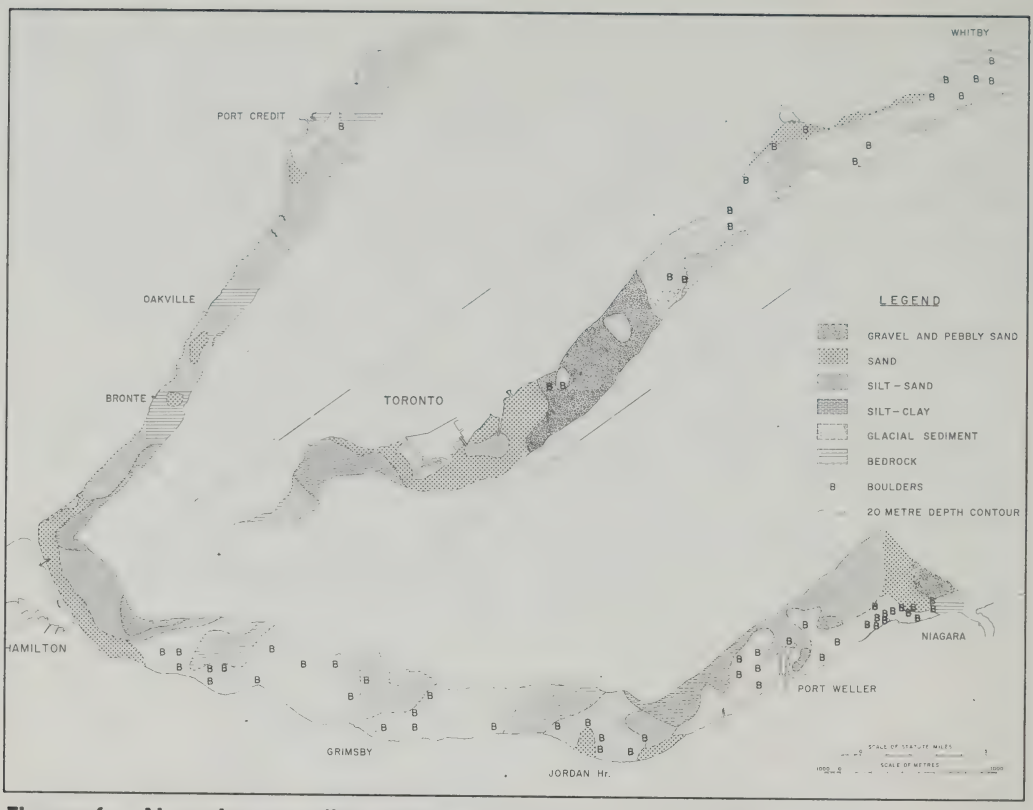


Figure 6. Nearshore sediment type in Lake Ontario, 1968

tion of clay-silt mud. West of Humber Bay, exposed bedrock was capped at some locations by sand from the littoral drift.

Population in and around Toronto rose sharply in the early 20th century and in 1913 the Toronto Harbour Commissioners began several decades of the extensive lakefilling mentioned earlier. As industrialization of the area progressed, new chemical substances were introduced and, by the 1940s, serious toxic chemical contamination had occurred as a result of increased commercial production and widespread use of synthetic organic chemicals and metals. For example, sediment cores from the mouth of the Niagara River showed that concentration of chlorobenzenes, mirex, and PCBs in deposited sediments increased with the sales of those chemicals.

In 1973 the Water Quality Board of the International Joint Commission (IJC) identified the Toronto waterfront as a problem area due to bacteriological and chemical concentrations that failed to meet the water quality objectives specified in the Great Lakes Water Quality Agreement, 1972 (renewed in 1978 and 1987). The Water Quality Board adopted an ecosystem perspective in 1981 and evaluated sediments and biota, in addition to water quality. Under this system, the Metropolitan Toronto waterfront was designated one of Ontario's 17 "areas of concern." A Remedial Action Plan (RAP), currently under development, is to address the degraded environment in an ecosystem context.

Changes in Plant and Animal Life

Evaluation of data accumulated at the Toronto Island Filtration Plant indicates that the mean annual biomass of phytoplankton doubled between 1923 and 1954, with a shift in dominant species. In the mid-1960s, studies identified excessive quantities of nutrients in Lake Ontario caused by the increased discharge of phosphates in detergents, and surface run-off containing synthetic inorganic fertilizers.

By the 1950s, the combination of habitat loss, water quality degradation, and over-harvesting had led to the collapse of the once-valuable lake trout fishery of western Lake Ontario. The number of frogs, turtles, and snakes had rapidly declined in the first half of the 20th century and some species are now classified as rare. Moreover, some birds once seen frequently in the region, such as the peregrine falcon, caspian tern, and least bittern, are seldom sighted.

It has been estimated that more than 90 per cent of fish production occurs within the shallow water zone — which is precisely where many physical disruptions have occurred because of erosion control projects and lakefilling. By 1960, only isolated areas of natural habitat, such as the Rattray and Lynde marshes, existed on the shoreline between Burlington and Newcastle. As a direct consequence of shoreline alterations, much of the nearshore spawning habitat for certain cold-water species was destroyed. The silt released and embayments created changed the aquatic environment and contributed to changes in the community of flora and fauna.

Terrestrial habitats were lost with the urbanization of the shore and the general loss of open space. The open space that did remain was in isolated pockets, and subject to severe grooming guided by landscape ideals that called for structured, formal lawn and tree combinations. The result was a very narrow range of acceptable plants and animals.

Beginning in the 1940s, chemical contamination (probably by PCBs or pesticides) was responsible for the decline of populations of herring gulls, black-crowned night herons, and cormorants in the Toronto area. Restrictions on the use of such chemicals allowed the herons and gulls to recover, but the bald eagle has yet to return to Toronto's shores. Although no longer in use, traces of some chemicals linger in water, sediments, plants, and tissues, a measure of the time it takes certain chemicals to break down completely. The use of PCBs and mirex, for example, has been banned for several years but, to this day, both are found in fish taken from Lake Ontario.

A comparison between the days of early settlement and the present makes it clear that the loss of species and diversity has been dramatic. It is generally agreed that the largest single factor has been the loss of both quantity and quality of habitat, which has been continuous since European settlement in the area. It started with forest clearing, filling or destroying lakeshore and estuary

marshes, removing protective nearshore stone deposits, and, finally, replacing sloping sand or cobble beaches with vertical steep walls of timber, stone, steel, concrete rubble or even earth fill for so-called shore protection.

The direct impact of all that activity on water quality is difficult to quantify, partly because there is no historical data base, and partly because the cumulative impact of toxic chemicals on aquatic biota is still poorly understood.

Fish population is an indicator of the health of the ecosystem because fish depend on a complex web of plants and invertebrates. The number of species has dropped from historical levels of more than 50 to 27 at the best location in the region, the Rouge River. In such highly polluted sites as the Keating Channel, the count has dropped to seven. Not only are there fewer species, the mix has changed, with fewer cold-water fish like lake trout, and more of the hardy warm water bottom feeders like catfish and bullhead.

Sources of Pollution

Although the mass loading via the Niagara River remains the greatest contaminant input to Lake Ontario, sources in the GTB have more direct impact in the Toronto area of concern. Local sources are listed below in approximate order of impact, and are discussed in more detail in Chapter 2.

- sewage treatment plants, including material bypassed;
- urban stormwater run-off, including stormwater and combined sewer overflows, connected tributary streams and rivers, and snow disposal;
- industrial effluent (discharged to the sewer system);
- dredging, dredge spoil disposal, and lakefill activity;
- pollution from abandoned industrial and waste disposal sites.

Most of the contaminants associated with the above-mentioned discharges are attached to very fine particulate matter. Prior to 1960, the littoral zone in western Lake Ontario — excepting Humber Bay, Toronto Harbour, and Burlington Beach — was a dynamic, non-depositional area: sediments were removed and deposited elsewhere. Contaminants were dispersed and transported offshore to the deep depositional zones of the lake.

The lakefill headlands constructed in the last two decades have been put there to provide harbours with calm water for small craft — ideal conditions for depositing suspended sediment. In addition, the sheltered areas around each lakefill diminished lake current and, as a result, the deposition of material increased. Unfortunately, much of this material was contaminated.

A Ministry of the Environment (MOE) study using sediment traps found that contaminants related to major point sources were dispersed across the

Toronto waterfront to create a uniformly contaminated suspended sediment. As a result, all the lakefills built to date have in-place pollutant problems. These will persist, at least until all sources of contaminants can be controlled.

In addition to the contaminated sediments captured at lakefill sites by coastal processes, some of the lakefill material is contaminated because 95 per cent of it is excavated soil from urban construction sites. Repeated surveys from 1980 to 1990 show that between 15 and 50 per cent of the truck-dumped fill did not meet the MOE criteria for open water disposal. While some of this material was placed in "protected" and "confined" areas, there is no doubt that a significant portion was exposed to the lake.

Bioaccumulation studies were carried out by the MOE to determine if contaminants are accumulated in plants and animals. They show that, in some cases, there has been bioconcentration in bottom creatures and in the tissue of small fish such as sculpins — that is, there was more contaminant in the fish than in the surrounding sediment. Significantly, the highest invertebrate tissue-to-sediment concentration ratio in the Toronto study area was near the tip of the Leslie Street Spit. The test species showed substantial concentration of mercury relative to their surrounding sediment. The ratios were: mercury (25 times), copper (17 times), cadmium (12 times), and zinc (31 times).

There is a great deal of research still to be done to establish the mechanism by which contaminants move between sediment and biota. However, there are adequate data to conclude that contaminated sediments are a direct source of contaminants in the food chain. The preliminary results of tests using cages of clams located at various sites indicate some uptake of contaminants. But clams are primarily indicators of material in the water, rather than sediment, because of their water filter feeding method.

Sediment contamination can also affect water quality through resuspension, which is believed to be a factor in the closure of Toronto's beaches for extended periods each summer.

Today the nearshore zone of Lake Ontario is heavily utilized by competing and conflicting users, as is evident in the Etobicoke area (see Figure 7). Lakefill at the mouth of Mimico Creek adversely affects dispersion of waste from the Humber Sewage Treatment Plant and has created seriously contaminated sediments. As shown at the left side of the figure, the Lakeview Sewage Treatment Plant (STP) discharge is located to the east of the coal-fired Lakeview Generating Station. Under some conditions, effluent from the Lakeview STP is drawn into the generating station cooling water via the long entrance groynes and is discharged to the west, near the drinking water intakes for South Peel.

Map of Etobicoke/Lake Ontario Shoreline

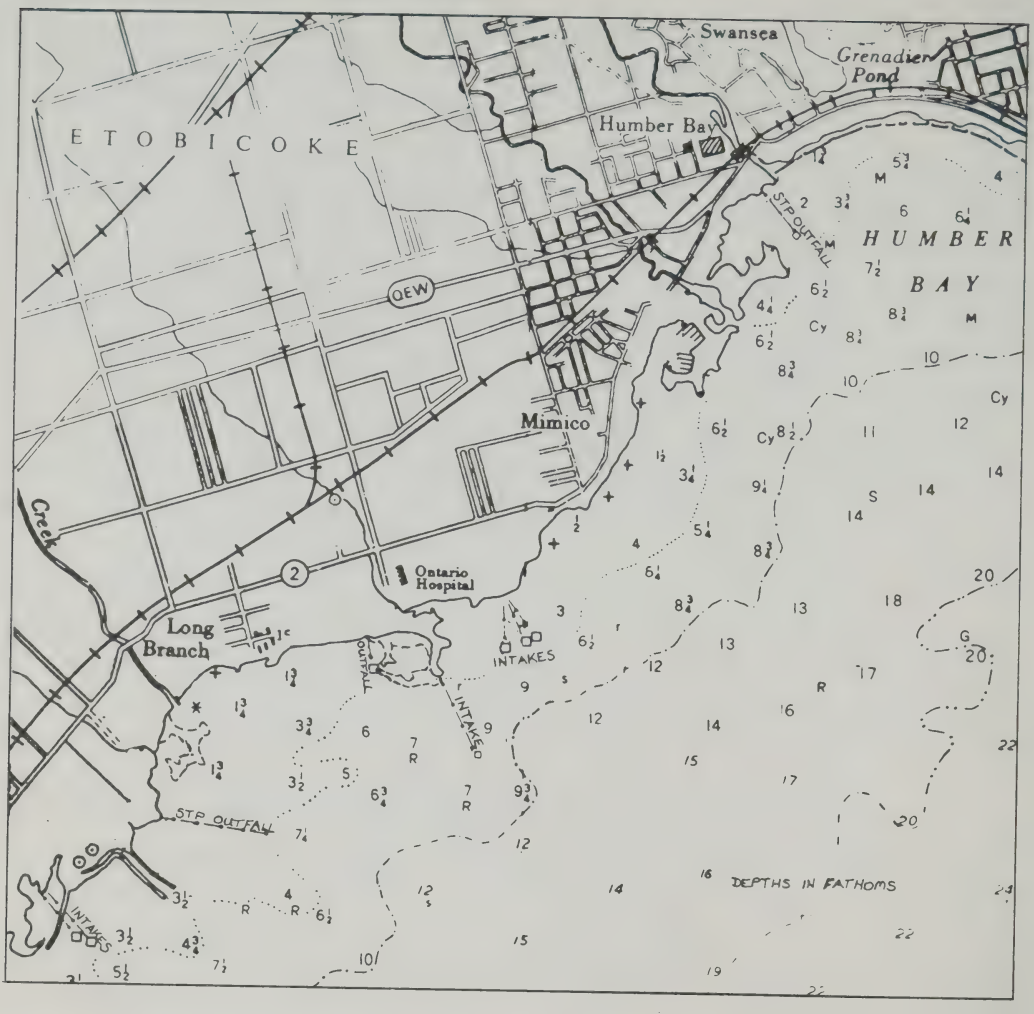


Figure 7. Etobicoke shoreline

In 1983, a new diffuser was added to the Lakeview STP outfall to improve initial dilution and reduce the impact of the discharges on the intakes and on recreational use at the lakefill.

A park and marina have been built on lakefill in the discharge area over the water intake pipes and further extensive lakefilling has been proposed in front and to either side of the generating station. A new drinking water intake extending about one kilometre (0.62 miles) further offshore is now being constructed in an effort to improve raw water quality. This build-and-then-fix approach illustrates the pattern of unforecast problems, fragmented planning, and conflicting use of the waterfront.

A Bird's-Eye View of the Shore of the Greater Toronto Bioregion

Flying over the western shoreline of Lake Ontario, one is struck by the intensity of development: from the end of the sand beach of the Burlington Bar to Oakville, much of the shoreline is protected with hard coverings (revetments) of concrete, rubble, and large quarried stone (armourstone), as well as short groynes jutting into the lake. Occasional narrow cobblestone or gravel beaches remain.

The lack of a large beach at either side of the Oakville Creek harbour entrance groynes suggests that littoral transport is not large here. Further east, the St. Lawrence Cement Co. and Petro Canada concrete piers stretch offshore to navigable water. Residential development surrounds one of the few remaining wetlands, the Rattray Marsh, which is protected from the lake by its tree-covered barrier beach bar.

Further to the east, as the shale subsides below lake level, a different shore forms, one that is low and sandy, created from fine glacial material near Lorne Park west of Port Credit.

At Port Credit, commercial and industrial development mixes with public open space built on reclaimed land behind steep stone revetments. A major lakefill structure east of the Credit River provides marina facilities next to the

Aerial view of Port Credit

heavily armoured shoreline of the Lakeview Generating Station and Lakeview Sewage Treatment Plant.

The dominant features on the Metro Toronto waterfront are lakefill structures. The Colonel Samuel Smith Waterfront Area at Kipling Avenue projects 700 metres (770 yards) from a low-density residential area. Four kilometres to the east, the Humber lakefill extends over nearly two kilometres (1.3 miles) of high-density residential and commercial shoreline. A breakwall remaining from the 1912 Toronto Harbour Commissioners' plan protects low parkland from the mouth of the Humber River to the lakefill structure that supports Ontario Place.

The west shore of the Toronto Islands offers one of the longest sand beaches remaining on the waterfront. The south shore has been fortified with a rubble mound breakwater, groynes, and a concrete seawall. Cut off from its supply of sand by the Leslie Street Spit, the shore is experiencing accelerated erosion. The Ward's Island beach, anchored by the new Eastern Gap entrance structure, has re-oriented itself to face southwest. Nearly all the shore of the Inner Harbour is vertical concrete and steel. The Outer Harbour has been created by the Leslie Street Spit, a lakefill structure now extending five kilometres (three miles) into 16 metres (52 feet) of water, protected by a veneer of eroding concrete, brick, and asphalt rubble.

Immediately next to the spit is the Ashbridge's Bay lakefill, where the east-facing embayment has filled with littoral sand. Beyond the groynes and breakwalls along the Eastern Beaches rise the Scarborough Bluffs, where the Metropolitan Toronto and Region Conservation Authority (MTRCA) is installing shore protection constructed of fill and rubble. The sharp incline of the bluffs is caused by erosion, the result of wave action on the underwater base of the bluffs. The unprotected bluffs retreat at a rate averaging a third of a metre (one foot) per year. Bluffer's Park lakefill at the foot of Brimley Road occupies nearly two kilometres (1.2 miles) of shoreline and extends 600 metres (660 yards) offshore, intercepting all littoral drift from the east.

Near East Point, the residential development at the top of the bluffs gives way to open space and scattered industrial use. Much of the shoreline is in a natural state although occasional storm sewer outfalls intrude.

Further east, Frenchman's Bay is separated from Lake Ontario by a natural sand bar broken by an entrance structure to permit navigation. Pickering Generating Station is built partly on reclaimed land with heavy armourstone revetments and cooling water intake groynes.

From Pickering to Whitby the shoreline is characterized by low bluffs two to seven metres (23 feet) high, with low-density residential or agricultural uses predominating. Various creeks have small estuarine wetlands behind gravelly beaches and bars. The estuary at Whitby long ago became a commercial har-

bour with entrance groynes interrupting the sand and gravel bar. From Whitby to Oshawa the shoreline varies from seven-metre (23-foot) bluffs descending to stream estuaries, each fronted by a small beach. Much of the land is low-density residential or cottage-lined beaches.

On the east side of the Oshawa Harbour entrance groynes, reclaimed land has been created by construction of a confined dredge spoil disposal facility (CDF). The Oshawa Second Marsh is a large estuarine wetland next to the more exposed McLaughlin Bay. From Darlington Provincial Park, the shoreline rises to bluffs 12 metres (40 feet) high, which occasionally "slump" towards the lake. Darlington Generating Station, built partly on reclaimed land, has massive armourstone revetments across its extensive shoreline.

At Raby Head, the bluffs are some 12 metres (40 feet) high, descending to a small coastal wetland just west of a large cement company dock, where a 32-hectare (79-acre) lakefill structure projects 675 metres (738 yards) into the lake.

Continuing east, the shoreline is a series of 10-metre (33-foot) bluffs, cut by creeks with small estuarine marshes behind sand and gravel baymouth bars. At Port Darlington and Bond Head the estuaries have been partially dredged for marinas and the bars are cut by entrance groynes. Farther east the pattern repeats, with some bluffs reaching as high as 20 metres (66 feet). Vegetation on these bluffs suggests a lower rate of erosion. Behind the bluffs, the area is almost entirely agricultural.

Summary of the Shoreline Situation

The extent of artificial change along the shore varies directly with the concentration of human activity and industrialization in that area.

Across the Greater Toronto Bioregion, the movement of littoral sands and current has been altered by the creation of artificial headlands, shoreline armouring, and lakefilling. Both the amount of material released and the location of deposition have changed. Within the GTB, the least impact on physical and coastal processes has taken place east of Toronto.

Degradation of water quality is greatest where the sewage plants and storm sewers discharge. At those points, which are most concentrated in Metro Toronto, sediments and water are contaminated, and the diversity of flora and fauna has been reduced.

Aquatic and terrestrial habitat have been substantially altered, particularly on the Metro waterfront. Steep stone, steel or concrete walls have replaced stream mouth marshes, sloping shores, and shallow water along more than 70 per cent of the western shore. Estuaries have been developed, dredged or altered, a pattern that has reduced the habitat potential. Contamination and tur-

bidity in the water have generally decreased the feeding and spawning capacity of the region and various changes have substantially reduced food resources.

East of Metro, the situation is significantly better, and some productive habitat remains intact.

In summary, the best places for saving shoreline habitats are in Durham and the eastern parts of Metro while, in the western part of the municipality, and in Peel and Halton, there is the greatest need for shoreline rehabilitation.

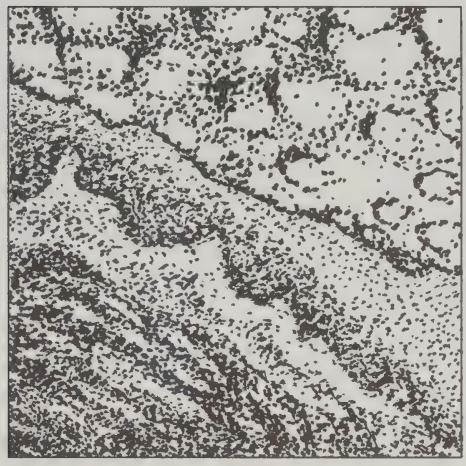
CHAPTER 2

SHORELINE REGENERATION ISSUES

This chapter describes the issues that arise from changes to the shoreline between Burlington and Newcastle, under the following broad headings:

- Shoreline Modification;
- Waste Disposal;
- Water and Sediment Quality;
- Habitat, Aquatic and Terrestrial; and
- Quality of Life.

Shoreline Modification



Land that exists or can be created on the GTB waterfront is amongst the most valuable in Canada. This alone is a powerful motive for protecting what exists, and adding more where it can be created at reasonable cost. Other justifications advanced for shoreline modification, of which lakefilling is but one category, include the desire to create public access, parks, recreational boat facilities, public utilities, ports, transportation corridors, industrial land and wildlife habitat.

There are three major categories of shoreline modification employed in the GTB:

- lakefilling, the practice of displacing the lake to create new land by depositing rubble, excavation materials, dredge spoils, and other materials;
- erosion control, a variety of measures involving rubble, stone, soft fill, and engineered materials, to inhibit the erosion of the shore; and
- other modifications including rubble reefs for fish habitat, breakwaters, piers, sewage outfalls, water intakes, etc.

Past attempts to modify the shoreline have had mixed success. Some met the primary objectives for which they were designed, but had unforecast side effects. For example, Bluffer's Park has provided many desirable boat berths, and some public space, but its location and design interfered with mixing and dispersal of polluted water and, as a result, created contaminated embayments. Moreover, this artificial headland has blocked the movement of sand towards the Toronto beaches, and may accelerate the erosion of nearby bluffs.

Unplanned results can be positive as well, such as the near-urban wild area that has emerged on the Leslie Street Spit. Other projects, such as the many private attempts to stop property erosion, have failed and collapsed within ten years, while still others may have accelerated the erosion of their neighbours' shore.

State of the Art

An important consideration in shoreline modification is the state of the art: the extent of knowledge and proven ability that defines the options which can be considered with confidence. Among the questions that have to be answered:

- Can coastal engineers design and build structures that will stand up to the forces of nature, and are there standards for such structures?
- Can experts predict the impact of structures on erosion and deposition, currents, littoral transport, and other coastal dynamics?

Coastal Structure Reliability

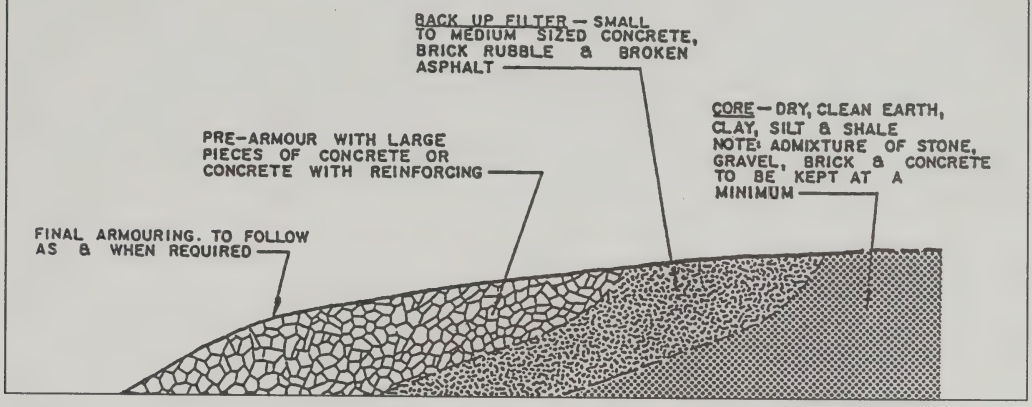
Engineers designing structures in the Great Lakes can draw on world-wide experience, as well as on the many projects on the GTB waterfront. Considerable information on the construction of artificial headlands has been presented at the Colonel Samuel Smith Environmental Assessment hearings, and in *An Evaluation of Lakefilling Activities in Ontario*, prepared in February 1988 for the Ontario Ministry of the Environment by the Environmental Applications Group and F.J. Reinders and Associates. Evidence was presented at the environmental assessment hearing and in the report concerning advanced techniques for the construction of beaches and dissipation of wave energy (see Figures 8a, 8b, 8c).

After 70 years of lakefill, there is considerable expertise in the Great Lakes area: in the GTB, the conservation authorities, particularly MTRCA, have implemented shoreline erosion control measures for decades. While every situation is a little different from every other one, the weight of evidence would suggest that there is the know-how to deal with conventional design of lakefill structures and to maintain the physical integrity of headlands and shore erosion, as long as the cycle of water levels in Lake Ontario remains within a relatively narrow range.

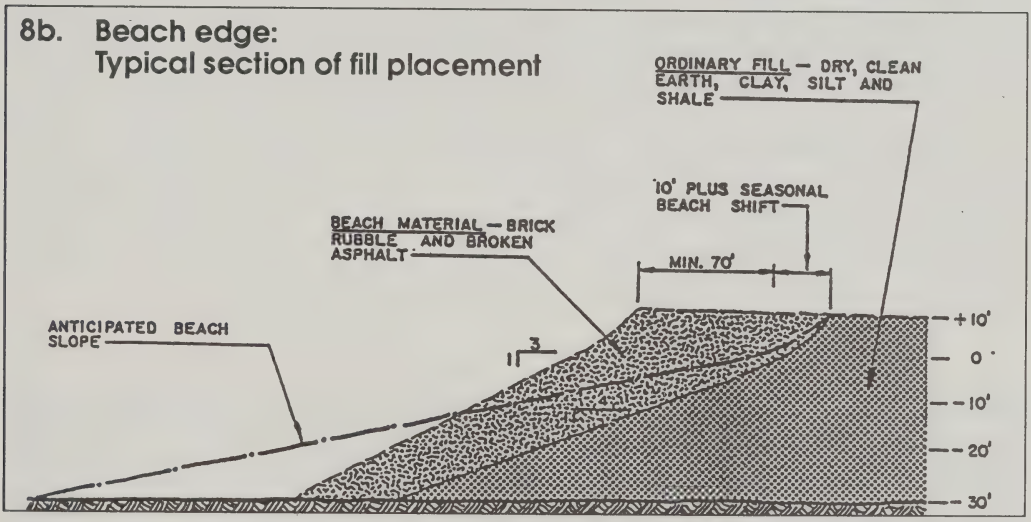
But lake levels are the wild card. Wave energy is dissipated, and erosion takes place, in very different places depending on water levels. Structures that are reliable under current conditions would be overwhelmed if lake levels were two metres (6.6 feet) higher, and undermined if they were two metres lower. The possibility of global warming and climatic change has given rise to a wide range of opinions on the net effect, or even whether lake levels will rise or fall.

Figure 8. Lakefill construction techniques

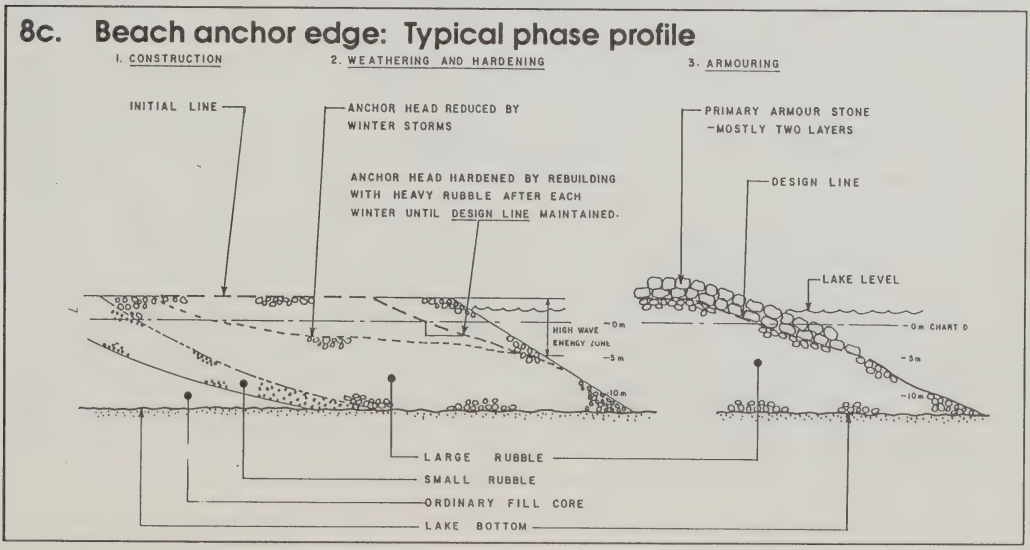
8a. Armoured edge: Typical section of fill placement



8b. Beach edge: Typical section of fill placement



8c. Beach anchor edge: Typical phase profile



Assuming that change would occur gradually, it seems reasonable to be confident about properly constructed structures over 10 years, but there is much less certainty when considering them over 100 years.

At present, there is no construction code governing coastal structures in Ontario: each project depends on the skill and experience of the professionals employed, the amount of money available, the thoroughness of any environmental assessment, and the adequacy of construction and maintenance. There is a lack of agreed-on criteria for design, including such key questions as what range of lake levels and what severity of storms should be considered.

Project cost rises substantially as the range of possible events, such as storms, is included in the design capability. In addition, design standards should reflect the severity of consequences in the event of failure. Ontario Hydro employs a very costly standard at Pickering because of the consequences of loss or damage to a nuclear plant. Loss of a recreational headland may be judged in terms of the boats and fixtures at risk, and could justify a less expensive standard. If, however, we are considering a structure such as that at the Leslie Street Spit, which contains large quantities of contaminated material, more expensive measures should be taken.

Another concern is assurance that a project will be constructed and maintained according to the original design and to any commitments made by proponents to approval agencies. The current lack of post-construction assessment of large undertakings is a significant weakness because there is a natural temptation to solve budget problems by completing certain elements "later."

Concrete debris on shore

In summary, it would appear that coastal engineering expertise and experience exist for common structures, but the key issues are applying appropriate standards for the risks, ensuring that these standards are respected during and after construction and assessing cumulative effects of the projects.

Coastal Dynamics

One of the uncertainties in modifying the shoreline is the impact on coastal dynamics. How will proposed changes affect erosion, deposition, transport of sand, currents, and dispersal of sewage or stormwater discharges? The answers are important in determining the consequences of various physical changes, nearby as well as remote from the project.

In the past, individuals whose properties have been damaged have been hampered in obtaining compensation because so much shoreline alteration is undertaken by government agencies, and lawsuits against the Crown are notoriously difficult to pursue successfully. Furthermore, the impact (such as the destruction of fish habitat) is often diffuse, and borne by the public, which owns a great deal of shorefront property. It is quite possible that greater care would be taken if the proponent of a project were required to pay the full cost of any consequences of that project.

Included in the considerable information on shoreline dynamics in the GTB is identification of currents, littoral drift, and areas of erosion and deposition. Models have been developed to simulate the shoreline action and estimate the energy to be dissipated under various wind and wave conditions. From this, reasonable inferences can be drawn as to areas of erosion and deposition, and estimates made of the "order of magnitude" of those phenomena.

Order of magnitude means that, for example, if it is estimated that there will be sand deposits of 1,000 units per year, the expected result will be more than 100 and less than 10,000 units per year. Professionals qualify the prediction further by pointing out that lake levels and infrequent storms can have a major impact on what actually happens. Moreover, there are constant changes along the shore, and various barriers and structures interact with each other with consequences that make precise long-range predictions very difficult.

Nonetheless, it appears that there are sufficient data and expertise to make general assessments of the impact of major physical changes on the shoreline. At this point, the detail and precision of these estimates is limited to order-of-magnitude measurements over a period of time, and are subject to there being no major changes in lake levels or to the adjacent shore structures. While precision is not possible, these predictions can be of great value in assessing broad aspects of project feasibility, alternatives, location, design, consequences, and mitigation.

Other Issues

One significant problem in dealing with shoreline modification is the calculation of cumulative effects. If every project is examined in isolation from the rest of the ecosystem, the apparent impact may be acceptable. One hundred metres (110 yards) of shallow nearshore eliminated by steep stone armouring of the shore for erosion control may not measurably affect the fishery, or a downstream beach. But what is the impact of 10 kilometres (six miles) of such a treatment? What planning processes and legislation will deal properly with this problem? Who gets the benefit, and who pays the costs, particularly the environmental costs?

In many cases the project proponent gets the apparent benefit, but the costs are widely spread or, to use the economist's term, the proponent "externalizes" the costs.

Questions about payment and benefits, as well as the benefits of lakefilling and shoreline erosion control, can be applied to waterlots. Should public property such as waterlots be transferred from the provincial Crown to private hands, and to what extent should private entities benefit from modifications of the public shoreline? Shoreline erosion control is an expensive undertaking, there are side affects, and effectiveness is varied. When should such measures be undertaken? Should the public pay for them? Are there any alternative approaches to managing these hazard lands?

Lakefill Marina/Boat Club Parks

The 1967 Waterfront Plan spawned numerous large marina/boat club parks based on lakefill at intervals along the GTB waterfront. These artificial headlands have emerged as an alternative to traditional river and stream mouth marinas, despite their negative consequences, which include:

- obstruction of the longshore movement of littoral sands, current changes, and related problems of erosion and sand accumulation;
- interference with dispersal of contaminants when they are located near sewage outfalls, storm sewer discharge, and polluted streams and rivers;
- creation of embayments that trap contaminated sediments;
- introduction of pollution to the lake through contaminated fill materials;
- congestion and traffic problems on roads entering the parks; and
- obstruction of the view from the original shoreline.

On the other hand, they have been very popular because they engender local activity, and offer public access to the water, walks and new vistas, picnicking, and opportunities to launch boats. They are particularly attractive to owners of large boats because they provide moderately-priced moorage and adjacent winter storage that would not be available otherwise. These berths were so popular that the Metro Parks department estimated that, in 1988, the unsatisfied demand amounted to more than 2,000 berths in the Metro Toronto area. Some of this enthusiasm may be related to the fact that boaters pay little or nothing for the construction or maintenance of the lakefill structures that support and enclose their leased properties. Examination of the Colonel Samuel Smith Waterfront Area is instructive.

Private boat club on lakefilled Humber Bay Park West

Colonel Samuel Smith Waterfront Area: Project Review

The unsatisfied demand for boat berths has been used as justification for constructing a series of artificial headlands along the shore of the greater Toronto region. It is interesting to note that marinas constructed by public agencies have dominated the new installations in recent years.

Colonel Samuel Smith Waterfront Area is typical of the artificial headland parks along the shore, where private boat clubs and related boat basins dominate. The size and shape of the new headland, which stands at the foot of Kipling Avenue, were determined specifically to protect boats moored at the docks from waves and storms. Colonel Samuel Smith Waterfront Area is nearing completion, and it is revealing to compare the approved plan with the current situation.

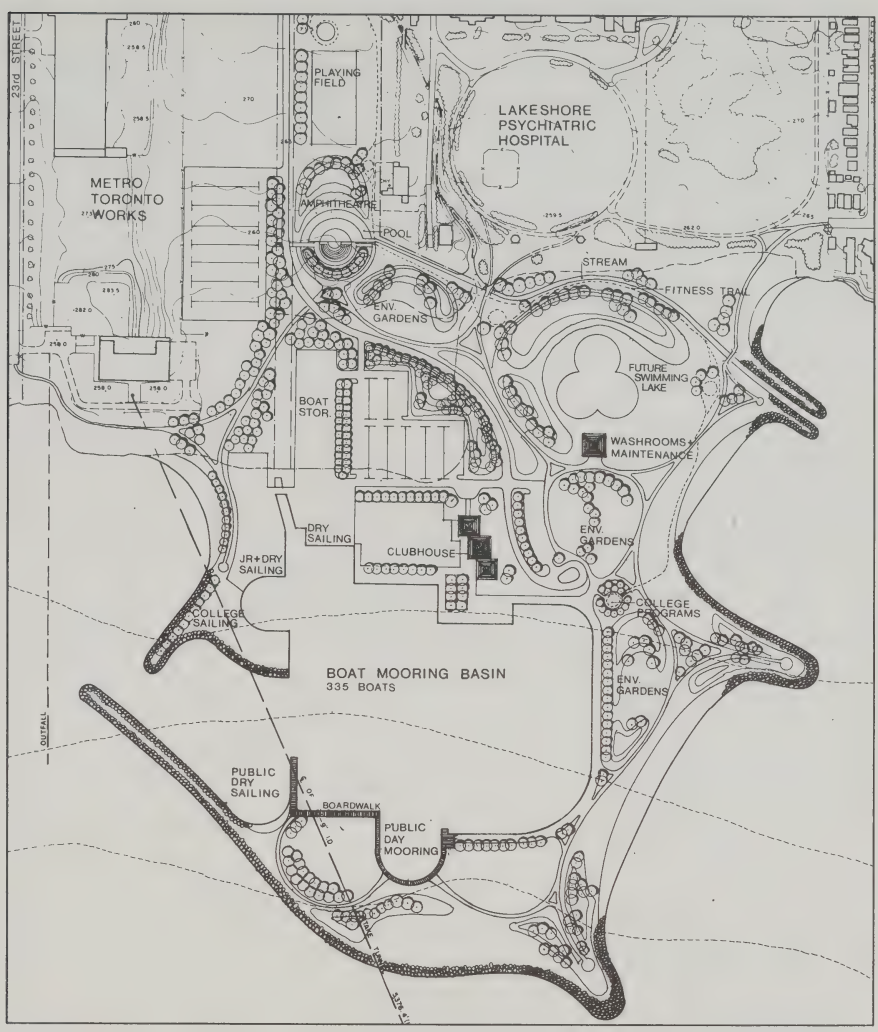
When the headland was proposed by the Metropolitan Toronto and Region Conservation Authority (MTRCA), a long list of public amenities was included, in addition to the boat basin — presumably to justify public support and funding. These included an amphitheatre with seating for 500, playing fields, an artificial swimming lake, environmental gardens, a fitness trail, an educational display area, sunbathing beaches, public day moorings for 40 boats, and public parking for 50 cars adjacent to the boat club, with parking for 170 cars shared with Humber College. The original plan is illustrated in Figure 9.

Table 2. Current status: Colonel Samuel Smith Waterfront Area

Item	Approved Plan (1980)	Current Outlook (June 1991)
Private Facilities		
Boat Clubs		
• wet mooring	335	500
• dry sailing	165	0
Humber College		
• wet mooring	5	5
• dry sailing	15	15
Buildings	Clubhouse	Clubhouse
Parking		
• by boat basin	220	500
• by filtration plant	180	0
Public Facilities		
Docking		
• wet mooring	40	20
• dry sailing (beach)	yes	?
Parking		
• amphitheatre	100	0
• general park use	70	0
• plant site	180	0
• by boat basin	50	0
Band Shell / Amphitheatre Seating	400-500	cancelled
Playing Fields	1 hectare	no funds
Swimming Lake	0.4 hectare	no funds
Environmental Gardens	yes	no funds
Education Display	yes	no funds
Fitness Trail	3-4 km	some trail in 1993
Washrooms & Maintenance Bldg.	yes	yes
Picknicking and Viewing	yes	yes

Sources: MTRCA Staff, 1991
Colonel Samuel Smith Waterfront Area Environmental Assessment

Figure 9. Colonel Samuel Smith Waterfront Area Master Plan



A recent review of this MTRCA project by the Work Group revealed that most of the public amenities have been cancelled or have no funding and no specific date for completion. See Table 2 for a comparison of the plan, as presented to a hearing of the Environmental Assessment Board, with the current outlook.

Financial Summary

The costs of constructing Colonel Samuel Smith Waterfront Area are substantially higher than originally forecast. This is not surprising, given the high rate of inflation between 1978 and 1991. Regardless of the explanation, many additional dollars must be found to complete the work, which is estimated to cost a total of $8.6 million, even in its substantially scaled-down version. The MTRCA portion of capital costs to date has been financed, in the main,

Table 3. Financial summary: Colonel Samuel Smith Waterfront Area

	Item ($ million)	Subtotals ($ million)
Financing Headland and Boat Basin		
MTRCA		
Revenue from dumping fees at Colonel Samuel Smith	1.3	
Revenue from Leslie St. dumping	0.4	
Subtotal MTRCA	1.7	1.7
Boat Clubs	0	
Public		
Metro grants to date	1.9	
Provincial grants to date	1.2	
Subtotal to date	3.1	
Balance expected		
• Metro	1.9	
• Provincial	1.9	
Subtotal Public Grants	6.9	6.9
Grand Total (Latest Cost to Completion - June 1991)		8.6
Original Project Cost (excluding items deleted)		4.4

Source: MTRCA staff, 1991

through "tipping" (fees for dumping) revenue of $1.3 million and as the result of a surplus from other sources. The balance of $6.9 million is expected to come from Metro and provincial grants, as summarized in Table 3.

The total area of the park is 31.3 hectares (77.5 acres), comprising three hectares (7.4 acres) of mainland, 18.4 hectares (45.7 acres) of lakefill, and 9.9 hectares (24.4 acres) of protected water in the boat basin. Once complete, the park will be turned over to the Metro Parks Department, which will manage the facility, provide services, and lease the land and water to private boat clubs.

MTRCA will maintain and repair the headland indefinitely, at no charge to Metro or its tenants.

The tenants or boat clubs will be responsible for the cost of their own docks, clubhouse, and fixtures. Phase I of development will require approximately $1.1 million. While the boat clubs will pay lease charges for the space they occupy in the harbour, the amount is modest, and under the terms of their lease some services must be provided by Metro and the MTRCA from this payment. Moreover, there have been proposals that even the modest lease charge be waived in the initial years, but this has not yet been approved.

Boat Club Share of Headland Costs

The boat clubs paid no part of the capital cost to construct the headland that creates the boat basin, and the lease charge reflects little, if any, of the capital or headland maintenance cost. Table 4a examines three ways of estimating the proportion of headland that might be attributed to the private organizations: first, by assessing the proportion of land and water assigned to the clubs as a proportion of the (45.7 acres) that were added, primarily to create the boat basin. The second approach allocates share of the total costs on the basis of boat berths (private vs public) — the rationale being that the shape of the headland and much of the special design was necessary only to produce sheltered boat berths. Third, a rough visual assessment of useful land created (over and above what already existed) suggests that 70 per cent will be used by the boaters, for their parking lots, and for winter storage space. (Other allocations are possible.)

Table 4b shows that the capital subsidy to the private boat clubs ranges between $5,700 and $12,700 per berth.

Colonel Samuel Smith Waterfront Area has many similarities to the other marina/boat club parks. The boat basin is the dominant feature in all of them. Some of the others provide more public space and amenities, benefits which may be added to the waterfront Area as it matures. It is important to note that no provision for the environmental cost of these facilities has been included, other than for preparing the initial assessment and monitoring program. On the other hand, there are economic and recreational spin-off benefits from encouraging recreational boating, including boat building, chartering and tourism, and related services. The question remains, however, whether subsidies of this magnitude are necessary to attract boaters.

There are two issues that arise from this analysis:

- What is an appropriate charge to private boat clubs and marinas for the use and maintenance of the headland?
- What would be the demand for berths if the full costs, including environmental costs, were levied?

Table 4. Capital subsidy estimates: Colonel Samuel Smith Waterfront Area

4a. Three options to allocate share of waterfront

	Proposed Lease Area		Berths		Visual Estimate
Private (Boat Clubs & College)	(Hectares)	(%)	(#)	(%)	(%)
Public	8	43	500	96	70
			20		
	10.5	57	20	4	30
Totals	18.5	100	540	100	100

Source: MTRCA
Shoreline Regeneration Work Group

4b. Share of capital subsidy

	Leased Area	Berths	Visual Estimate
Private (Boat Clubs & College)	($ million)	($ million)	($ million)
Public	3.0	6.6	4.8
	3.9	0.3	2.1
Totals	6.9	6.9	6.9
Apparent Subsidy/Private Berth	$5 700	$12 700	$9 200

Source: MTRCA Staff, 1991
Shoreline Regeneration Work Group

These issues deserve public discussion when further development of Colonel Samuel Smith Waterfront Area and other artificial headlands such as East Point Park in Scarborough are proposed.

Shoreline Armouring and Erosion Control

Because of the power of the predominant onshore winds and waves, structures intended to slow or stop erosion of the exposed shore are common along the GTB shoreline. They are sometimes constructed by conservation authorities, as in the case of the MTRCA's work at the foot of the Scarborough Bluffs. The structures created by private landowners attempting to protect their property are often undertaken without professional advice, although the Ministry of Natural Resources or local conservation authorities will sometimes make suggestions if asked.

The materials used vary widely and include bricks, broken pavement, stones in wire baskets, rubber tires, quarry stone, and poured concrete. The results have been just as variable because the structures must prevail against a wide range of water levels, ice, and changing wind and wave directions. Many have failed within a decade and some structures may have unwittingly accelerated erosion at the toe of the slope, because of poor design and as the result of ignorance about the effects of wave action.

While the benefits of shoreline armouring are immediate, the negative effects are often delayed. For example, structures may:

- accelerate erosion as a result of changes in the current and transfer of sand;
- interrupt or prevent sand accretion, a benefit that is part of the riparian rights of beach owners downshore; and
- reduce fish spawning beds and cause changes in the warm shallow-water zone that is critical to food production and aquatic plant life, as a refuge from the deadly cold-water upwellings typical of Lake Ontario.

The Ministry of Natural Resources has recently compiled a draft *Great Lakes-St. Lawrence River Flood and Erosion Policy Statement*, based on the principle that effective shoreline management can occur only on the basis of a littoral cell — a section or compartment of shoreline where there is little or no exchange of littoral sands with adjacent cells. The preferred approach is to prevent flood and erosion damage by appropriate land-use planning; however,

Erosion control - private efforts

protecting existing property by constructing revetments and breakwaters is also recognized, if there will be no downstream effects.

If the guidelines in the policy statement are adopted, they would meet some of the concerns about shoreline projects expressed in the *Watershed* report. However, they do not address a number of other important issues, including:

- the need for comprehensive shoreline planning on an ecosystem basis, recognizing natural and habitat values as well as hazards;
- the importance of measuring cumulative environmental effects;
- the importance of assessing the costs and benefits of shoreline regeneration; and
- the positive results of ensuring public involvement in shoreline protection and management.

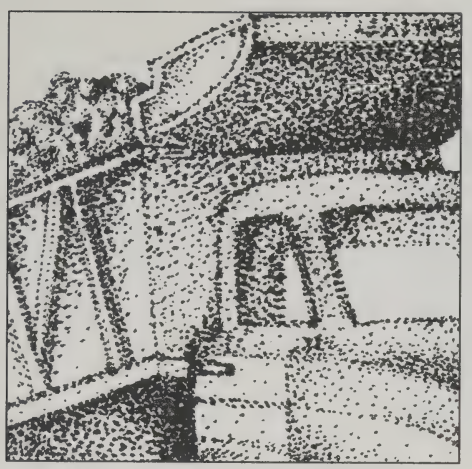
Summary of Shoreline Modification Issues

Modifying the shoreline by lakefilling and controlling erosion has provided the GTB with substantial benefits: protected private land, new land for development and public purposes, public access to the waterfront, transportation corridors, and an urban wilderness on the Leslie Street Spit. There has been a substantial contribution to the economy of the region, and to many forms of recreation enjoyed by tens of thousands of people each year. At the same time, however, these structures have required public subsidy, interfered with the movement of sand and the lake's ability to rinse its shoreline, and helped contaminate the lake and the creatures that live in or near its waters.

The shoreline regeneration issues arising from this discussion include the following:

- Should lakefilling and erosion control be permitted?
- If so, what kind, where, and under what conditions and systems of approval and control?
- Can lakefill be carried out without introducing contaminated material to the lake?
- Can lakefill be designed and constructed so it has a neutral or positive impact on the ecosystem?
- What are the alternatives to building erosion control structures?

They are discussed in Chapter 4: Options and Recommendations, while the question of using public money to protect private lands from erosion, or to construct headlands for private boat clubs, is left for public discussion and hearings related to specific projects.



Waste Disposal

Disposal of unwanted materials has always been one of the two primary reasons for lakefill activity.

> For decades [lakefilling] was perceived to be an inexpensive and highly profitable way of achieving two goals simultaneously: creating new land, at minimal expense, which could be used for air, road, and rail transportation, industry, port facilities, recreational purposes, etc., and at the same time, disposing of unwanted bulky material, with minimal haulage costs, simply by dumping it into the lake at the City's waterfront. (Royal Commission on the Future of the Toronto Waterfront, Environment and Health Work Group, *Environment and Health*, 1989, 49)

Certainly lakefill has been perceived as a waste disposal issue. The 1980 environmental assessment hearing for the Colonel Samuel Smith Waterfront Area elicited this comment from one intervenor:

> I am in favour of parks. I am also in favour of apple pie and motherhood. Excuse my sarcasm, but I feel the issue here is not one of who is in favour of parks. The issue is whether to dump fill into Lake Ontario and at what cost.

There are two primary sources of lakefill: construction wastes including soft fill from excavation bricks and rubble, and dredge spoil, the silty material removed from channels and harbours to aid navigation.

It is important to recognize that the construction waste disposal aspect of lakefill is primarily a Metro Toronto phenomenon and not really an issue for the rest of the GTB. Construction industry representatives and MTRCA officials agree that very little material is used from sites north of Lawrence Avenue or east or west of Metro's borders. Mississauga has been able to dispose of the great majority of its fill on-site or as daily cover in its landfill. At times, MTRCA has been forced to forego tipping fees at the Colonel Samuel Smith lakefill at the foot of Kipling Avenue, in order to entice truckers to bring material.

In the Toronto core, however, high-density development, and deep excavations for below-ground parking lots and malls have generated great volumes of fill. Extremely high land values and building density discourage surface dis-

Dump trucks on Leslie Street Spit

posal. The fact that the entire area has been subject to occupation, landfilling, and various industrial activities means that contamination of the excavated material is common. The result is an extraordinary situation in which there is a need to find a low-cost, convenient place for disposing of large volumes of partly contaminated fill. While this problem may spread in the event of higher-density development east and west of Toronto, it will remain primarily an issue for the central waterfront portion of Metro Toronto.

While the construction waste disposal issue affects a small portion of the GTB, the magnitude of the problem is very large. As outlined in Table 5, the primary source of lakefill is found in private-sector construction, while accumulated sediments that will eventually require dredging are a small factor.

Lakefill Materials Management and Control

Waste disposal in Ontario falls in the purview of the Ministry of the Environment. MOE regulates waste disposal under the authority of the Environmental Protection Act (EPA), Part V. The regulatory system has three major components:

Table 5. Metropolitan Toronto bulk construction wastes Projected average disposal, 1984-2000

Source	Cubic metres/yr (000)	Tonnes/yr (000)
Private-sector construction	620	930
Public works	91	120
Subtotal	711	1,050
Estimated sediment from the Don River	50	
TOTAL	761	

Source: Work Group calculations based on data from *An Evaluation of Lakefilling Activities in Ontario: Final Report*, Environmental Applications Group et al, 1988, 199, 201.

- classifying wastes;
- granting approvals for the operation of waste disposal sites; and
- monitoring and enforcing regulations to ensure that classification and approval requirements are met.

Classification is particularly important because material, once classified as waste, can be legally disposed of only in an approved waste disposal site. For the purposes of this report, three categories of waste are relevant:

- hazardous waste;
- solid waste; and
- exempted waste.

Construction materials have been classified by MOE as "inert fill", which is an exempted waste under Part V of the EPA. Inert fill, according to MTRCA's manual, refers to

> earth or rock fill or waste of a similar nature that contains no putrescible materials or soluble or decomposable chemical substances.... This material may be disposed of in any suitable location. (Trow, Dames, and Moore, *The Manual for an Improved Lakefill Quality Control Program*, 1990, 8)

This definition has meant that such materials could be legally placed in Lake Ontario without approval being sought for use of the lake as a waste disposal site. MOE disputes the interpretation, on the grounds that the material is not exempt, but it has traditionally left the matter to MTRCA.

Dredged sediments that fail to meet Open Water Disposal Guidelines, which specify maximum content of certain contaminants, are classified as waste material, and must be conveyed to a confined disposal facility, such as the MOE-approved site in Whitby Harbour.

A waste disposal site must be designed and operated in accordance with MOE standards set out as conditions of the Certificate of Approval issued for that site. Failure to comply with those standards is illegal and leaves the operator open to prosecution by MOE.

In the 1980s, when MOE introduced a regulatory program in Metro Toronto to ensure that polluted soil was not placed in the lake. This program required contractors to gain approval before lakefilling at MTRCA and THC sites.

Standards governing waste disposal are enforced at two levels: the MOE requires generators to send materials to approved sites (for instance, they may not send hazardous wastes to a site that has a certificate authorizing acceptance of solid wastes only). Second, site operators refuse to allow entry of illegal

materials. The major problem for the site operators lies in identifying such materials, especially if they are mixed with other, legal wastes.

Construction Materials

The provincial Ministry of the Environment has not actively regulated lakefill since 1971. Concerns about pollution from contaminated soil led to development of the Lakefill Quality Assurance Program (LQAP), which was initiated by MOE in 1982. In 1987 Ministry studies showed that "material deposited since the inception of the LQAP largely exceeded various parameters of the MOE Open Water Disposal Guidelines." (MTRCA, *A Comprehensive Review of the Improved Lakefill Quality Control Program for 1989*, 1990, 1)

Because of the ineffectiveness of LQAP, a second program known as the Improved Lakefill Quality Control Program (ILQCP) was developed. In a letter dated 27 April 1988, the then-Minister, Jim Bradley, wrote to W.T. Foster, chairman of MTRCA, asking the authority to act "on the Ministry's behalf for the administration" of the ILQCP on the Metro Toronto waterfront, apparently because MOE lacked the resources to carry out the program. At least in part, the problem was economic: according to provincial policy, fees charged by MOE under the plan must be directed to the Provincial Treasury, not to the Ministry. MTRCA, however, may retain the tipping fees, use them to expand staff, and direct surplus funds to other projects.

Administration of the Improved Lakefill Quality Control Program

The ILQCP, administered by MTRCA, went into effect on 1 January 1989; it is based on a classification of construction materials according to their suitability for open water disposal, as restricted disposal (lakefilled but with less direct contact with water) or as ineligible for lakefill. On 1 July 1989, the Toronto Harbour Commissioners ruled that only chemically tested material that met the Open Water Disposal Guidelines would be allowed as lakefill at the Leslie Street Spit. Thus, there are now only two categories of fill permitted.

The program has the same three basic components as the MOE waste regulation programs:

- MTRCA considers applications for lakefilling, which leads to classification of materials;
- it issues approvals in the form of bills of lading;
- MTRCA monitors lakefilling according to those approvals, to ensure that pollution standards are met, that operators comply with legislation, and that regulations are enforced and illegal lakefilling deterred.

MTRCA has attempted to improve the process and the program has undergone modifications. The following is a description of its components as of 1 January 1991.

Anyone wishing to lakefill must submit an application to MTRCA, which must approve lakefilling activities in the Metro area. In addition, proponents of large sites — defined as producing more than 200 cubic metres (260 cubic yards) of material — must submit a site history audit and results of site sampling and chemical analysis. (Small sites have been required to submit such information since January 1991.)

Under Regulation 309 of the Environmental Protection Act, materials not acceptable for lakefill must be sent to an approved waste disposal site; those accepted for lakefill will be disposed of, according to one of the following options:

- in open water;
- at sites protected by land on three sides;
- at confined sites, i.e., those having no contact with water.

In 1990, 96.6 per cent of lakefill was sent to open water placement, 0.6 per cent to protected and 2.8 per cent to confined sites.

Once an excavation site is accepted for some form of lakefill, the owner is issued bills of lading which are then presented by the hauler to MTRCA staff as each load is brought to the lakefill location.

In 1990, 1.1 million cubic metres (1.4 million cubic yards) of material were approved for lakefill. Slightly more than 10 per cent was ultimately rejected.

A bill of lading must be presented before a load can be used as lakefill. This control is augmented by:

- visual inspection of loads as they enter the lakefill site;
- random sampling of loads at the lakefill site and by subsequent chemical analysis; and
- random auditing of excavation sites.

According to MTRCA, the program operated at 75-per-cent efficiency in 1989. In 1990, 107 random samples were taken from large-site loads as they were being lakefilled and subjected to chemical analysis. Sixteen samples, or 15-per-cent, exceeded the open water placement approval that had been given. The program was described as "85-per-cent efficient" for large sites.

The Province seeks compliance with the ILQCP by advertising in construction trade journals to remind operators of the requirements of the program, and it distributes a manual that explains how ILQCP works.

The fact that material exceeded approved standards in 15 per cent of loads checked was detected after the loads had been used as lakefill: it takes two weeks to get laboratory test results.

The major sanction available to the site operator is to ban the hauler from further use of the disposal site. The practice followed by MTRCA when a spot-check analysis shows that standards have not been met is to suspend further truckloads from that construction site until an explanation is provided by the contractor. Often, construction has been completed by the time results are available.

Critique of the Improved Lakefill Quality Control Program (ILQCP)

The ILQCP is very similar to, and presumably modelled on, the manifest system used to monitor and regulate off-site hazardous waste disposal in Ontario, although the latter is somewhat more sophisticated: waybills must be completed by the companies generating, hauling, and disposing of waste. These are then submitted to the MOE, providing a complete paper trail of the transaction. Although there is not enough information available to compare the two programs, the ILQCP probably stands up well, in terms of ratio of staff and financing to number of generators and total quantity of material regulated. (It is certainly more sophisticated and better financed than monitoring and compliance measures taken at almost all solid waste landfills in Ontario.)

As we know, there were no serious penalties for placing sub-standard fill in the lake. The major weakness of the program seems to be the absence of sanctions in the form of prosecution. A number of successful, well publicized court actions would probably help raise the rate of acceptable fill.

If MTRCA were required to obtain a Certificate of Approval for any lakefilling activity it conducted, the violation of standards that took place in 1990 might lead to prosecution of MTRCA by the Ministry — which would provide an incentive to the Authority to make sure haulers were complying with the program. MTRCA might do that by implementing a policy of withdrawing access to low-cost lakefill disposal to those haulers who seriously or repeatedly fail to comply with standards.

There are two further problems with MTRCA operating the ILQCP. First in general, it is considered poor public policy to have a body both regulate and participate in a given activity. But MTRCA carries out lakefill projects for its own purposes as well as regulating fill quality in the Metro area. While MTRCA is to be commended for initiating this pioneering program, an apparent conflict of interest would be removed if MOE administered the program.

Second, MTRCA lacks the power to issue certificates directly to those wishing to dispose of materials through lakefilling and to prosecute those who

fail to comply with the terms of the certificates. MOE has such power and consequently is better equipped to control lakefilling.

Dredging

Dredging is just one aspect of a larger problem: shoreline environmental stress caused by contaminated sediments that are washed downstream and deposited at the river mouth; this is the situation at rivers such as the Credit, Humber, and Don. At several places in the GTB, rivermouths are used for navigation, and therefore, deposited sediments are periodically removed by dredging. During the earlier part of the century, the dredged materials — termed "spoils" — were simply taken farther out into the lake and dumped. During the 1970s, however, when it became clear that some such sediments were contaminated, the MOE confined disposal of polluted sediments to specially constructed cells with the intention of isolating contaminants from the aquatic environment. At the Leslie Street Spit approximately 250,000 cubic metres (327,000 cubic yards) of the capacity of the confined disposal facility (CDF) has been used although the disposal cells remain part of the aquatic environment.

Limitations on Future Lakefilling

Concerns about the consequences of lakefilling have given rise to proposals to restrict the practice:

- a moratorium on new lakefill projects (but operations could continue at existing sites);
- an absolute ban on lakefill;
- increased restrictions on the materials used in lakefill (to meet MOE's new draft sediment guidelines).

The 1989 interim report of the Royal Commission on the Future of the Toronto Waterfront recommended that "A moratorium on all new lakefilling should be declared until a comprehensive policy is developed." Neither the previous nor the present Ontario governments have explicitly adopted this recommendation, but no new projects have been approved.

It is important to note that the moratorium proposed by the Royal Commission on new lakefilling does not prevent continued deposit at existing sites and projects. While the approved capacity of the Leslie Street Spit may be achieved by 1993, its effective capacity could be greatly increased by bringing underwater slopes to stable gradients, and by raising the elevation of existing dry land. Given this immense potential, a moratorium would concentrate, but not inhibit, lakefilling for many years. However, it would stop the proliferation of sites by suspending projects that are new or in the planning stages.

Table 6. Inventory of pits and quarries with in 25 kilometers of Toronto's central business district

Township	No. of pits/quarries	Size
Vaughan	21 pits	(5 over 25 hectares)
Toronto Gore	0	
Part of Chinguacousy	1 pit	
Markham	7 pits	(1 over 25 hectares)
Pickering	16 pits	(2 over 25 hectares)
Mississauga	3 pits	(3 over 25 hectares)
	4 quarries	
Total	52	

Source: Metropolitan Toronto, 1984

The issues raised by an absolute ban on lakefilling are very significant. First, it should be pointed out that the broken concrete and rubble are urgently required to replace the constant erosion of the hard veneer that protects the large quantities of soft material in existing lakefill structures. An exemption for rubble, or a costly alternative such as quarry stone, would be required to avoid failure of those structures.

Second, a very large amount of material, averaging 711,000 cubic metres (930,000 cubic yards) per year, would require alternate disposal. Given the scarcity of licensed sanitary landfill capacity, and Metro's determination to exclude construction wastes, a ban on lakefill would create an extremely large demand for alternate land disposal.

Increased restrictions on materials approved for lakefill, such as the new MOE sediment guidelines, would result in more material being rejected and requiring alternate land disposal. Such a development would present the same disposal problems as the ban, on a reduced scale.

Alternatives to Lakefill Disposal

There is an obvious need to establish a new regulatory system that would allow supervised land disposal of materials that are too contaminated to be placed in open water but can be safely deposited in locations other than an approved waste disposal facility like Keele Valley.

Metro Toronto has identified a number of worked-out pits and quarries within practical hauling distance of Toronto that could be used for this purpose

(see table 6). A large sand pit in the Brampton area, for example, is available for bulk materials, at haulage costs from the city core that would be similar to those for the Keele Valley sanitary landfill. However, ensuring that new sites do not cause environmental harm is a major issue. Some pits are quite permeable, and located near water sources. Any new sites must stand up to rigorous technical review and public assessment before they are designated. Local objections are likely, and delays in obtaining the necessary capacity must be expected.

Looking on the excavated fill as a resource rather than a problem may yield some positive alternatives. In the past, bulk material has been used to create ski hills, noise barriers, and other useful features in urban areas. Several large industrial areas in the City of Toronto are being assessed for redevelopment. It may be possible to beneficially employ construction excavate to cover existing areas, raise elevations, and generally improve the usefulness of those sites.

One way to eliminate pollution caused by dredging contaminated sediments is to control upstream pollution sources that cause the problem in the first place — direct discharges to the river, run-off from land, and depositions from the atmosphere — and to minimize erosion and thus the volume to be dredged.

There are three basic alternatives for disposal of dredge spoil:

- dilution (take it out by barge and dump in deep water);
- containment (remove it to confined disposal facilities such as the cells on the Leslie Street Spit); and
- remediation (some sort of treatment to remove and render harmless certain contaminants — presumably followed by a type of bulk disposal).

MOE considers any dredged sediments that exceed its Open Water Disposal Guidelines to be "waste" that must go to a CDF. The contamination commonly found in GTB dredge spoils defines and limits the material that can be disposed of by transport offshore.

Containment in sites adjacent to the water is the most common current means of disposal. The increased cost of transporting the material to remote land sites, and the scarcity of approved land sites, makes land disposal an unattractive alternative.

Remediation is the third possible approach to dredgeate disposal but must be recognized as being in the early stages of development. The cost of treatment measures depends on a number of factors, including the nature and concentration of the contamination, the targets for residual contaminants, the volume to be treated, and the availability of suitable technology.

The International Joint Commission (IJC) and other agencies are investigating potential technologies for remediation of contaminated sediments, includ-

ing such measures as chemical or biological treatment, and incineration. Whatever the method, costs are likely to be very high. The U.S. Army Corps of Engineers has estimated that research and planning, dredging, remediating, and disposing of 750,000 cubic metres (one million cubic yards) of contaminated sediments could cost $265 million U.S. (Northeast-Midwest Institue *Cleaning up Great Lakes Toxic Hotspots: How much will it cost? How can it be paid for?*, 1989, 17)

Similar methods can be used to treat contaminated soils. The THC is in the process of developing a program to remediate approximately two million tonnes (2.2 million tons) of contaminated soil in the Port Industrial District. The cost of washing the soil and then processing the resultant slurry is estimated to be $160 per tonne ($176 per ton), a total of $320 million. The THC has estimated that this cleaning method is cheaper than the cost of landfilling and replacing contaminated with clean soil, estimated at $400 million. Another pilot project to clean sediments is getting under way next to Hamilton Harbour, at an estimated cost of $500 per tonne ($550 per ton).

While remediation and bulk disposal may be an alternative for the worst contaminated dredge spoils, the issue that must be faced is the merit of expending scarce environmental clean-up dollars on large volumes of dredged material.

Summary of Waste Disposal Issues

Lakefilling has been a significant activity on the GTB shoreline for a century because it has been viewed as an inexpensive and convenient method of disposing of waste, particularly excavated materials. Waste disposal is an issue primarily in the downtown core of Metro Toronto because of the high volume of material produced from deep excavations, lack of on site disposal options, and the fact that the sites are partially contaminated by lead from vehicle exhaust and other pollutants from previous landfill and industrial activity.

A special system for controlling materials for lakefilling has been applied by the MTRCA at the request of MOE. This system includes guidelines for some contaminants, analysis of sites, bills of lading, approvals, disposal site control, and spot-checking of loads delivered. The system has reduced the level of contamination of materials for lakefilling, but further improvement is needed.

An absolute ban or greater restriction on lakefilling in Metro Toronto would result in the need to find reliable, low-cost alternative disposal sites for very large volumes of construction excavate. Given the scarcity of licensed sanitary landfill in the Metro area, finding suitable alternative disposal is another issue.

Water and Sediment Quality

We have already commented on the changes and general decline of water and sediment quality that took place as the population and industrial development increased in the GTB. Water and sediment quality are of concern because of the importance of lake water for drinking, bathing, recreation, food (mainly fish), and as the basis for a healthy, diverse shoreline environment.

While there are large quantities of contaminants in Lake Ontario from the Niagara River and other remote sources, they are diluted by a very large volume of water. Local sources, originating within the GTB, have a larger impact on the GTB shoreline because they are present in greater concentrations.

Local Sources of Contamination

Today, a flood of nutrients, organic chemicals, and heavy metals enter the water of Lake Ontario from a variety of sources within the Greater Toronto Bioregion. In 1985, the International Joint Commission (IJC) designated the Toronto waterfront as one of 42 pollution "hot spots" on the Great Lakes — areas in need of clean-up because of serious contamination.

The many rivers and tributaries flowing into Lake Ontario from the bioregion are major conduits for pollutants. Sources include: rural run-off, urban stormwater/snowmelt run-off, sewage treatment plant (STP) and industrial effluents, combined sewer overflows, groundwater seepage, and sediment leachate. The basic characteristics of selected pollution sources are described in Table 7.

The relative importance of various sources of pollution depends on the contaminant, and the point of impact. Figures 10a, 10b, and 10c show, by way of example, the relative annual contribution of suspended solids, lead, and copper to the waters of the Metropolitan Toronto waterfront. Information on STP and tributary loadings is derived from the Metro Toronto Remedial Action Plan report, *Environmental Conditions and Problem Definition*, published in 1988. The precise contribution from lakefill is not known, but three estimates are provided, based on the following assumptions:

- a 10-per-cent annual loss — dispersal in the water of 10 per cent of all fill material deposited during a year with typical volume. This loss

Table 7. Basic characteristics of selected pollution sources

Pollution Source	Hydraulic Load Characteristics	Type of entry into receiving waters	Primary Pollutants of Concern	Primary Impacts on the Receiving Waters
Sewage treatment plant (STP) effluents	Steady discharges with small variations	A point entry; sometimes with offshore diffusers	Solids, BOD, nutrients, bacteria, contaminants from industrial sources	Increased productivity, eutrophication
Sewage treatment plant Bypasses	Wet weather discharges preventing hydraulic overloading of the STP	A point entry	Solids, BOD, nutrients, bacteria, contaminants from industrial sources	Shock loads contributing to oxygen depletion, increased productivity, eutrophication
Industrial effluents	Variable discharges depending on industrial operations	A point entry	Industrial contaminants	Toxic effects, both acute and chronic, oxygen depletion
Tributary streams	Widely varying discharges, magnitudes depend on the basin area	Rivermouth, often discharging into confined embayments	Sediment, agricultural chemicals, nutrients, contaminants from urban sources (depending on land use)	Sedimentation, eutrophication, chronic toxicity
Urban run--off	Intermittent, greatly varying discharges	Numerous sewer outfalls, distributed through the urban area	Solids, bacteria, heavy metals, contaminants from industrial releases	Sedimentation, eutrophication/productivity, chronic toxicity
Snowmelt & disposal	Seasonal intermittent discharges with minor variations	Point entry through sewers, or at a point of snow disposal	Solids, chlorides, phosphorus, heavy metals	Toxicity, eutrophication/productivity
Combined Sewer Overflows (CSO)	Intermittent, varying discharges from combined sewers to prevent STP overloading in areas with combined sewerage	Point entry in many urban locations	Solids, BOD, bacteria, nutrients	Shock loads, depletion of oxygen, high bacteria levels,eutrophication/productivity

Source: J. Marsalek, (unpublished source)

estimate might be expected with year-round dumping, a broad unprotected filling area, and a serious storm;

- a five-per-cent annual loss, roughly what might be expected with typical volumes, with a broad unprotected filling area exposed to the waves year-round, such as that at the Leslie Street Spit;
- a one-per-cent annual loss, which might be achieved with a narrow, unprotected fill area, with filling restricted to calm weather and protected during storms.

For the purpose of these graphs, lead levels in fill were assumed to average 40 parts per million, and copper to average 25 parts per million, with the typical annual volume of material dumped equalling one million cubic metres (1.3 million cubic yards).

The three estimates of lakefill pollution are compared with storm and combined sewer discharges on the shoreline, the sewage treatment plants, the Don River, and all the major Metro rivers and creeks (including the Don).

Clearly, at the five-per-cent loss level, lakefilling has a significant local impact on pollution, although, with the possible exception of suspended solids, lakefill is generally not the largest source of pollution. Comparing the different levels of fill loss illustrates the improvement that can be achieved by care and control in placing and protecting fill.

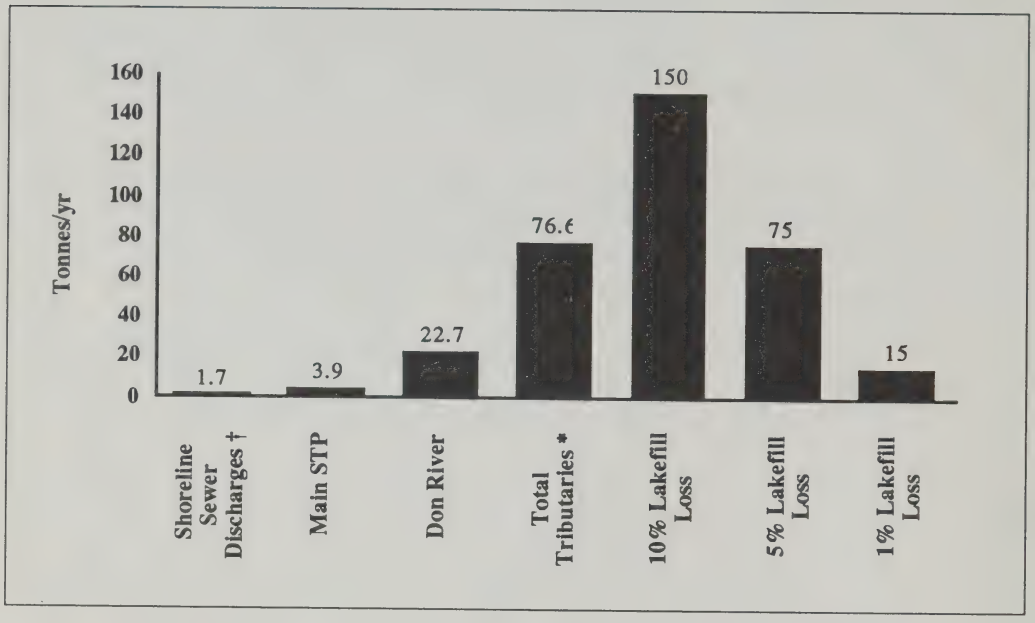
Several other sources contribute to GTB waterfront pollution, and may be significant locally.

Atmospheric deposition of chemicals and particulates from the area, as precipitation or dust, and ballast water discharges from ships are other sources of pollutants. (Ballast water has been responsible for the accidental introduction of a number of exotic organisms, including the prolific zebra mussel, and has added stress to the Great Lakes ecosystem.)

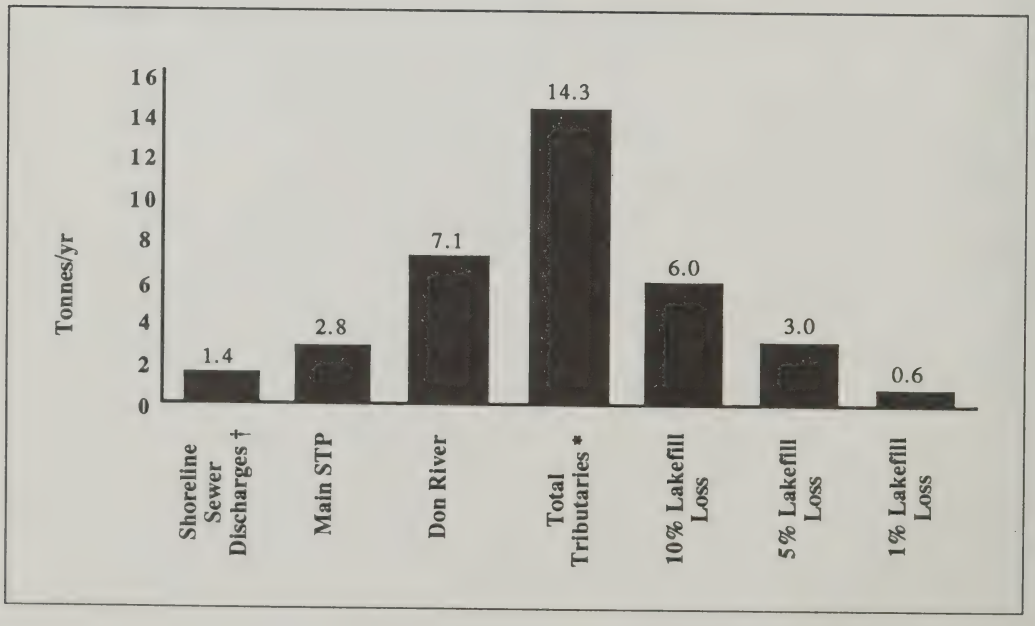
Water quality along the lakeshore is generally worse in the most urbanized areas adjacent to heavy concentrations of industry and sewage treatment, such as Metropolitan Toronto. Recent soil and groundwater testing on the central Toronto waterfront has shown extensive contamination by a variety of metals and organics. Contaminated groundwater and surface run-off from the area have been identified as potential sources of pollutants to the harbour and shipping channels. Worst of all are small areas of limited water circulation, such as embayments, especially where effluent is received directly. Studies have shown that embayments created by lakefill entrap water and sediment contaminated from other sources; as a result, they often have lower water and sediment quality than adjacent open-lake areas.

Figure 10. Metropolitan Toronto waterfront pollution sources

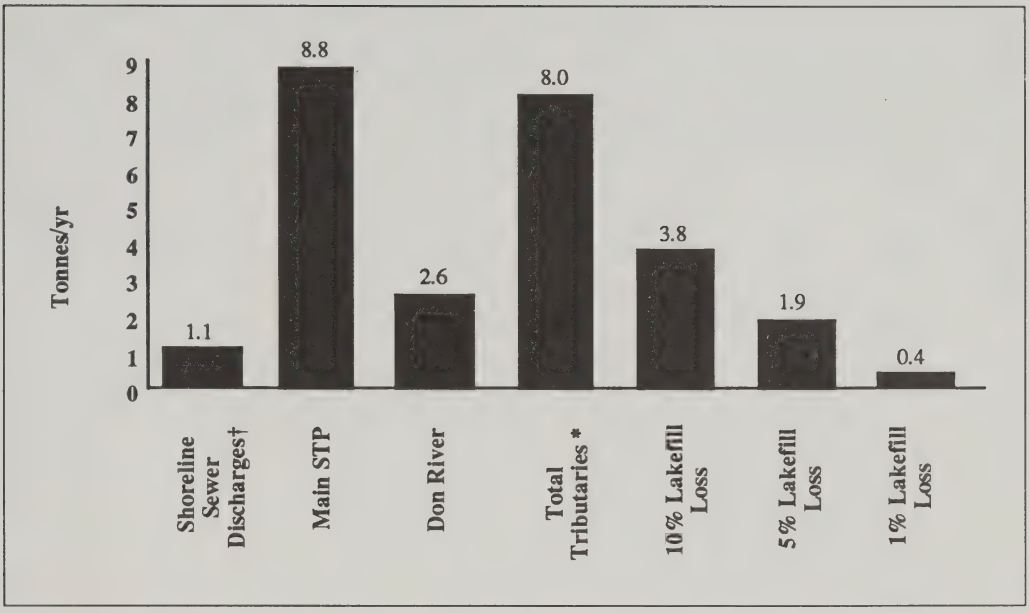
10a. Suspended Solids



10b. Lead



10c. Copper



Notes † Input from storm and combined sewers discharging on Lake Ontario shoreline.
* Tributaries include Etobicoke Creek, Mimico Creek, Humber River, Don River, Highland Creek, Rouge River.

Source: Metro Toronto Remedial Action Plan, *Environmental Conditions and Problem Definition*, September 1988.

Tributary Streams

Tributary streams convey land run-off as well as storm and combined sewer effluent to the lake. These discharges vary greatly, depending on the basin area, its physiographic characteristics, land use, climatic conditions, and effluent sources. Extensive paving and a lack of upstream holding capacity cause tributary discharges that increase quickly in response to rainfall. Higher discharges produce a rush of sediment and associated pollutants that have been dislodged upstream. In the GTB, headwaters of some tributaries like the Credit River are subject to the consequences of agricultural activity, but urban land use is the predominant cause of pollution in rivers and streams. In fact, the urban development of most tributaries in the GTB is so extensive that waterways like the Don River function as urban stormwater channels.

The primary pollutants in rivers include sediment from agricultural land or land under urban development, nutrients — especially phosphorus exported from the watershed with the eroded soil — and, at some times during the year,

Figure 11. Stormwater and combined sewer outfalls in the central Toronto waterfront area

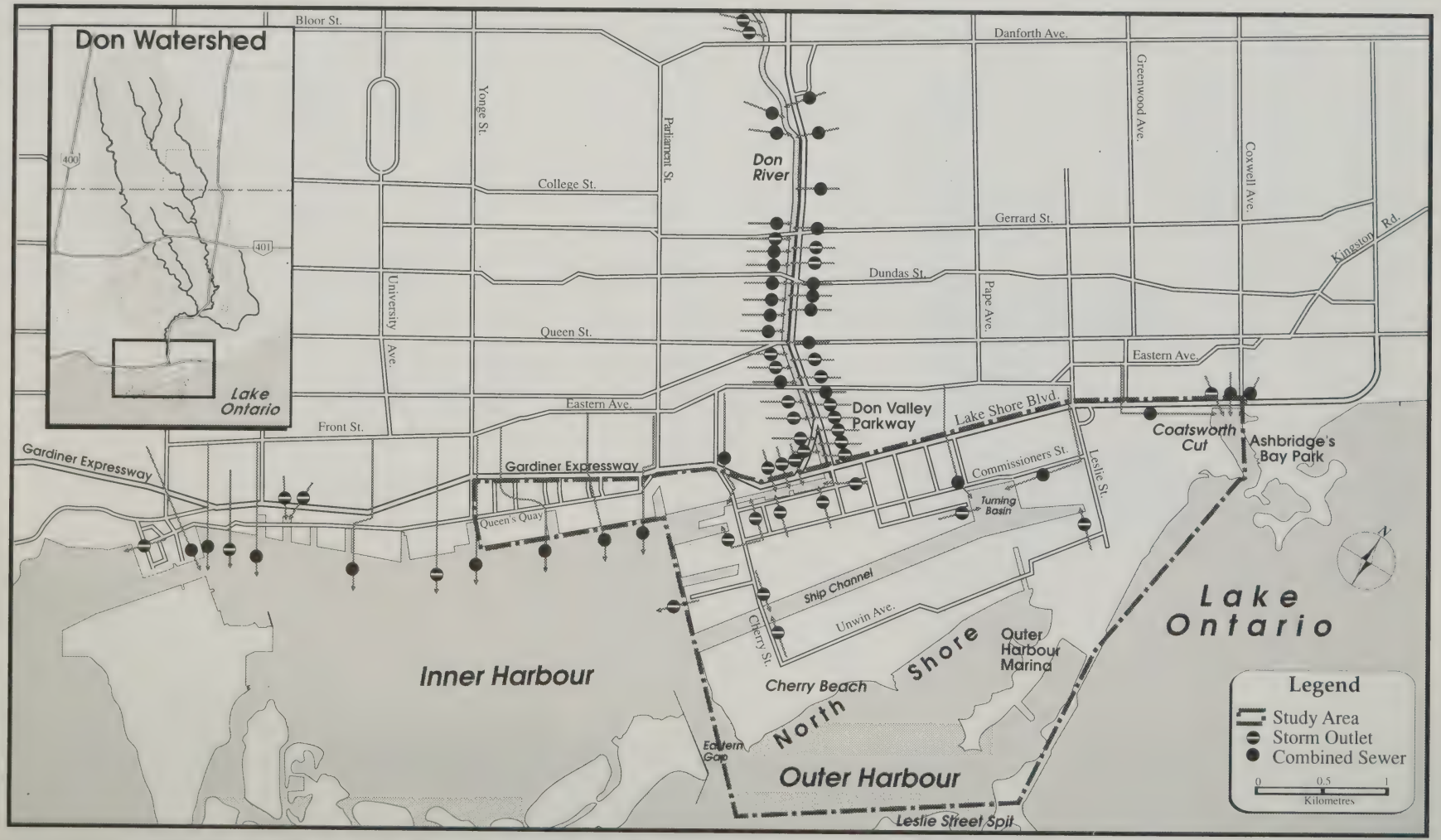


Table 8. Characteristics of major tributaries in the Toronto area

Tributary Name	Basin Area [km²]	Predominant Land Uses	Location of Stream Mouth	Sediment Yield [t/km²/yr]	Erosion Rate [mm/yr]
Duffin Creek	285	rural/urban	Ajax	110	0.042
Rouge River	379	urban/rural	Scarborough	128	0.048
Highland Creek	90	urban	Scarborough	238	0.090
Don River	392	urban	Toronto	236	0.089
Humber River	953	rural/urban	Toronto	158	0.060
Mimico Creek	87	urban	Etobicoke	241	0.091
Etobicoke Creek	213	urban/rural	Etobicoke	215	0.081
Credit River	881	rural/urban	Port Credit	108	0.041
Oakville Creek	387	rural/urban	Oakville	112	0.042
Fourteen Mile Creek	26	rural/urban	Oakville	112	0.042
Bronte Creek	338	rural/urban	Oakville	117	0.044

Source: E. D. Ongley, Sediment discharge from Canadian basins into Lake Ontario, 1973

agricultural chemicals such as fertilizers, herbicides, insecticides, and fungicides. The source of these pollutants is not solely agricultural: urban applications to lawns, golf courses, parks, and boulevards are significant. In addition, waters passing through urban areas receive drainage containing solids, bacteria, nutrients, metals, and biological oxygen demand (a measure of the loading of organic materials that consume oxygen as they decompose).

A list of tributaries in the Toronto area and their basic characteristics is given in Table 8.

Urban Stormwater Run-off

Stormwater run-off discharges occur throughout the urban area wherever storm sewers drain into nearby streams or directly into the lake. Such discharges are intermittent and vary from almost zero in dry weather to large wet-weather flows of tens of cubic metres (hundreds of cubic feet) per second, depending on the drainage area upstream, and the capacity to hold back water. Although the points of stormwater discharge can be identified for individual sewer pipes, there are so many they are often viewed as non-point sources of pollution. For example, 1,185 storm sewers and 30 combined sewer overflows (CSOs) discharge into the Don River. (The number and location of stormwater and CSOs in the central Toronto waterfront area is shown in Figure 11.)

The composition of run-off varies widely. There is a consensus that stormwater carries significant loadings of solids, metals (copper, lead, zinc),

Table 9. Characteristics of stormwater and combined sewer overflows in the Toronto area

Constituent	Constituent Concentration in mg/L, Except Fecal Coliform in Bacteria Numbers/100 mL					
	Stormwater			*Combined Sewer Overflows*		
	Mean	**Lower 95th Percentile**	**Upper 95th Percentile**	**Mean**	**Lower 95th Percentile**	**Upper 95th Percentile**
Total Suspended Solids	128.0	87.1	188.0	115.0	84.8	156.0
Chemical Oxygen Demand	740.0	527.0	1040.0	857.0	322.0	2280.0
Total Phosphorus	0.49	0.34	0.71	0.55	0.39	0.77
Total Kjeldal Nitrogen	2.42	1.94	3.03	2.54	2.15	3.01
Lead	0.046	0.038	0.055	0.063	0.049	0.081
Zinc	0.19	0.14	0.26	0.17	0.14	0.21
Copper	0.16	0.056	0.46	0.064	0.033	0.12
Fecal Coliform	403,000	10,000	16,200,000	543,000	29,600	9,970,000

Source: Paul Theil Associates and Beak Consultants, 1991

hydrocarbons, phosphorus, bacteria, and some industrial chemicals from local sources. Concerns about stormwater discharges follow from their impact on the receiving waters, as the result of sedimentation, increased nutrients, toxicity, and elevated stream temperatures that damage cold-water fisheries. Typical concentrations of pollutants in stormwater are shown in Table 9.

Some winter precipitation is stored on the catchment surface in the form of snow, which is removed from streets and sidewalks. Urban snow stores many pollutants from furnace emissions, inefficient operation of automobiles, increased wear of road surfaces, and applications of de-icing materials, particularly salt. In a typical winter, 65,000 tonnes (64,000 tons) of salt are spread in Metropolitan Toronto. The main concerns about snowmelt discharges are the high levels of chlorides, solids, and heavy metals, and the resulting toxic impact on receiving waters.

As snow melts, accumulated pollutants are released; some, such as acidic depositions, leave the snowpack early in the melting process, while others, such as polycyclic aromatic hydrocarbons (PAHs), remain in the pack until the last

traces of snow melt. Pollutants from the melting snowpack enter the storm sewers and are transported to the receiving waters in the same way as stormwater.

Significant quantities of snow are removed mechanically and transported to disposal sites. (The old practice of dumping snow in the lake or in streams was discontinued some time ago.) The most environmentally sound way to dispose of snow is on land at specially designed facilities. Regrettably, such a practice is not always followed. On-land snow disposal in the vicinity of streams (e.g., in the Don River Valley or on the waterfront) does not prevent snowmelt and the discharge of pollutants into receiving waters.

Sewage Treatment Plant Effluent

Municipal sewage comprising waste water from residences, commercial operations, institutional facilities, and, where permitted, some industrial operations, is treated at sewage treatment plants; the treated effluent is then discharged into the receiving waters. In the Greater Toronto Bioregion, secondary treatment is provided at all major STPs. Treated effluent, which has fairly constant flow rates, is discharged at single points into the receiving waters.

Important pollutants in secondary STP effluent include solids, biodegradable organics (described according to measurements of biochemical oxygen demand, that is the amount of oxygen consumed in decay), nutrients, bacteria, and contaminants from industrial sources. The most common impact of pollutants on receiving water comes from increases in productivity or eutrophication caused by nutrients such as phosphorus. The increased quantity of nutrients encourages the growth of algae, clouding the water and depleting the oxygen supply. Therefore, in many areas pollution control strategies require further reductions of phosphorus in STP effluent.

Recent environmental concerns have focused on toxic substances in municipal sewage. Some of these toxics are not removed by conventional treatment and are discharged into the receiving waters. Ongoing MOE study of this problem will provide extensive data on the fate of toxic substances in sewage treatment plants.

Table 10 is taken from a list prepared in 1989 by the Ontario Ministry of the Environment, showing major STPs in the Toronto area, daily discharge rates, and other characteristic data. The discharge rates can be related to the population served and the composition of the effluent can be related to STP design and the efficiency of its operation.

After precipitation, additional flow from surface run-off increases the discharges to municipal sewers and usually exceeds STP capacity. To protect the plant against hydraulic overloading, flows in excess of the plant capacity are discharged into the receiving waters in the form of the so-called "STP bypasses". This is wet-weather raw sewage that is discharged into the receiving

Table 10. Characteristics of major STPs in the Toronto area

Municipality	Name of Plant	Treatment	Watercourse	Population Served
Burlington	Skyway WPCP	conv. act. sludge with continuous P removal	Hamilton Harbour	120,100
Metro Toronto (Scarborough)	Highland Creek WPCP	conv. act. sludge with continuous P removal	Lake Ontario	310,000
Metro Toronto (Etobicoke)	Humber WPCP	conv. act. sludge with continuous P removal	Lake Ontario	540,000
Metro Toronto (Toronto)	Main WPCP	conv. act. sludge with continuous P removal	Lake Ontario	1,250,000
Metro Toronto (East York)	North Toronto WPCP	conv. act. sludge with continuous P removal	Don River	54,000
Mississauga	Clarkson WPCP South-Peel System	conv. act. sludge with continuous P removal	Lake Ontario	150,000
Mississauga	Lakeview WPCP South-Peel System	conv. act. sludge with continuous P removal	Lake Ontario	470,000
Oakville	South East WPCP	conv. act. sludge with continuous P removal	Lake Ontario	21,900
Oakville	South West WPCP	conv. act. sludge with continuous P removal	Lake Ontario	58,200
Pickering	Duffin Creek WPCP (York-Durham)	conv. act. sludge with continuous P removal	Lake Ontario	64,386

Source: Ontario Ministry of Environment Ontario Report on the 1988 discharges from sewage treatment plants in Ontario 1989

waters with little or no treatment. According to the MOE, the volume of effluent discharged by such bypasses is not known, because the only monitoring is a record of how long the bypasses last (commonly two to six hours).

The problems inherent in bypassing sewage are exacerbated by the fact that many STPs operate close to their design capacity — even small increases in flow can trigger the bypass. Moreover, in addition to raw sewage bypassing, secondary treatment bypassing can occur in the STP. The result is that partially

Table 10. Characteristics of major STPs in the Toronto area (continued)

Annual Average									
Daily Flow ($1000 m^3$)	Concentrations Influent (mg/l)			Effluent (mg/l)			Loading (kg/d)		
	BOD5	SS	TP	BOD5	SS	TP	BOD5	SS	TP
63.73	200.8	252.7	7.8	9.2	6.3	0.8	586.32	401.50	50.98
151.69	170.2	216.3	5.1	8.7	17.7	0.7	1319.70	2684.91	106.18
399.00	184.8	314.1	7.9	6.8	19.7	0.8	2713.20	7860.30	319.20
764.77	199.5	294.5	6.1	14.6	17.5	0.6	11165.64	13383.48	458.86
34.87	219.7	147.3	4.7	21.0	7.0	0.9	732.27	592.79	31.38
79.36	210.7	220.7	8.1	16.0	9.1	0.9	1269.76	722.18	71.42
255.14	236.6	228.5	6.7	5.7	10.1	0.5	4005.70	2576.91	127.57
14.74	145.4	154.2	6.5	4.4	5.5	0.5	64.86	81.07	7.37
33.74	280.7	232.9	7.1	8.8	10.1	0.6	296.91	340.77	20.24
187.45	149.6	215.9	6.4	24.3	14.9	0.9	4555.04	2793.01	168.71

Note: BOD5=Biological Oxygen Demand SS=Suspended Solids TP=Total Phosporus

treated sewage is being discharged to receiving waters. Pollutants typically include solids, biodegradable organics, bacteria, nutrients, and, possibly, contaminants from industrial sources. Concentrations of these constituents in bypasses resemble those in raw sewage ("Influent" as shown in Table 10) and are much higher than in treated effluent.

Table 11. Types of sewerage in the Toronto area

Municipality	Separate Sewer System	Combined Sewer System
Ajax	X	
Pickering	X	
Metropolitan Toronto		
Scarborough		X
East York		X
York		X
Etobicoke	X	
Mississauga	X	
Oakville	X	
Burlington	X	

Source: Gore and Storrie Limited, Review of problems within combined and partly combined sewerage systems in the province of Ontario 1979

Combined Sewer Overflows

Combined sewers were built in older parts of Canadian cities until the mid-1950s, to transport both municipal sewage and surface run-off. During rain storms, the capacity of combined sewers is exceeded by large inflows of stormwater and, to protect the sewer system against overloading and flooding, excess flows are allowed to escape from sewers in the form of the so-called combined sewer overflows (CSOs). These flows, a mixture of sanitary sewage and stormwater, enter the nearest stream or lake at a number of overflow points. The pollutant loads in CSOs generally exceed those in diluted sewage, because of the scouring of sludge deposits in combined sewers.

CSOs are intermittent, the frequency being decreased by various control measures. Nevertheless, in some areas, CSOs occur as frequently as 20 times per year. Overflow points are dispersed, but their numbers are substantially smaller than those for storm sewers. CSOs contribute shock loadings of solids, BODs , bacteria, and nutrients to the receiving waters. The results include elevated bacteria levels leading to beach closures, depletion of oxygen in smaller streams, and increased productivity/eutrophication. The extent of combined sewer systems in the Toronto area of concern is shown in Table 11.

Industrial Effluent

Discharge rates and characteristics of industrial effluent vary widely, depending on the type and size of the industrial facility.

Detailed information on the flow rates and composition of industrial discharges has been collected under the Province of Ontario's Municipal/Industrial Strategy for Abatement (MISA) program. MISA, which is being gradually implemented in individual industrial sectors, calls for monitoring of industrial

Table 12. Industrial effluent outfalls along the Toronto waterfront

Plant Name	Activity	Treatment	Location
Petro Canada Products	Petroleum Refining	Activated Sludge	Oakville
Union Carbide Canada	Packaged Gas	None (stormwater)	Oakville
Ford Motor Co.	Automob. Assembly	Primary Settling Lagoon	Oakville
St. Lawrence Cement	Masonry & Portland	Description Not Available	Mississauga
Petro Canada Products	Petroleum Refining	A.P.I. Separator, Oil skimming	Mississauga
Petro Canada Products	Petroleum Refining	A.P.I. Separator, Sand Filtration, Activated Sludge	Mississauga
Petro Canada Products	Petroleum Refining	A.P.I. Separator	Mississauga
Petro Canada Products	Petroleum Refining	A.P.I. Separator	Mississauga
Petro Canada Products	Petroleum Refining	Settling Basin, Oil Skimming	Mississauga
Texaco Canada Inc.	Petroleum Refining	A.P.I. Separator & Lagoon, Sec.Treat.	Mississauga
St. Lawrence Starch	Food Processing & Related Products	None	Mississauga
St. Lawrence Starch	Food Processing & Related Products	None	Mississauga
St. Lawrence Starch	Food Processing & Related Products	None	Mississauga
Lakeview TGS Ont. Hydro	Electrical Generating Station	Bar Racks, Vert. Travelling Screen	Mississauga
Chrysler Canada Ltd.	Automobile Parts Manufacturing	None	Etobicoke
Canada Malting Co.	Food Processing & Related Products	None	Toronto
Redpath Sugar	Food Processing & Related Products	Description Not Available	Toronto
Victory Soya Mills	Food Processing & Related Products	Description Not Available	Toronto
Texaco Canada Inc.	Lube Oil Blending	A.P.I. Separator	Toronto
R.L. Hearns TGS Ont. Hydro	Electrical Generating Station	Bar Racks, Vert. Travelling Screen	Toronto
Lever Brothers	Detergent and Soap Manufacturing	None	Toronto
Manson Insulation	Insulation Manufacturing	Primary Settling Lagoons	Scarborough
Manson Insulation	Insulation Manufacturing	None (stormwater)	Scarborough
Pickering NGS Ont. Hydro	Electrical Generating Station	Bar Racks, Vertical Travelling Screens	Pickering
Pickering NGS Ont. Hydro	Electrical Generating Station	Bar Racks, Vertical Travelling Screens	Pickering

Source: Ontario Ministry of Environment, 1990

Warning sign at Sunnyside beach

effluent; however, the data collected so far have not yet been published.

In general, concerns about industrial effluent are caused by the threat of an acute or chronic toxic impact on the receiving waters. Industrial outfalls along the Toronto waterfront, as listed by the Ontario Ministry of the Environment in 1990, are shown in Table 12.

A large portion of the Metropolitan Toronto waterfront area is, or was, the site of pollution-intensive industrial activity such as petroleum refining, which has led to widespread soil contamination. According to a 1976 report of the Central Waterfront Planning Committee, contaminants include toxic heavy metals (lead, cadmium), oil, coal, and salt. The potential impact of these sites on both the land and aquatic environment must be recognized. There are also problems from existing and abandoned industrial and sanitary waste-disposal sites near the shore; groundwater seepage and ongoing shore erosion may release contaminants to the nearshore waters of Lake Ontario.

The hazard posed by such sites — often abandoned, ignored contents unknown — was highlighted recently by a large mud slide in the Brimley Road area of the Scarborough Bluffs. It included large quantities of sanitary landfill debris from an unmarked site and, according to Dr. J.P. Coakley at the National Water Research Institute, there are at least three more abandoned sites in the same area.

Swimming Water Quality

It is common for inshore recreational waters in close proximity to large urban areas to fail the Canadian recreational water quality guideline of 200 faecal coliform per 100 millilitres (57 fecal coliform per ounce) during summer months. Fecal coliform in these areas commonly originate from sewage plant overloading or urban stormwater run-off.

Experience gained from studies of stormwater-induced pollution indicates that elevated fecal coliform counts persist for up to four days in nearshore recreational areas.

The contribution of lakefilling to fecal contamination is indirect: lakefill often blocks effluent dispersion and, as a result, elevated bacteria counts may

persist longer than would otherwise be the case. Lakefill can trap bacteria in sediment that, on resuspension, degrade water quality.

Fish and Water Contamination

The Province of Ontario has water quality objectives that vary for different intended water uses. The most restrictive objectives are usually those for drinking water and for protecting fish and aquatic life.

Recently those objectives have been called into question by the National Wildlife Federation, and the Canadian Institute for Environmental Law and Policy, on the basis that:

- they may not protect babies from developmental harm;
- objectives for cancer-causing chemicals do not protect people who eat more than the average number of Great Lakes fish;
- they ignore the cumulative effects of the numerous different toxic chemicals found in the Great Lakes.

Raw and treated drinking water from most water treatment plants in the Greater Toronto Bioregion is tested once a month in Toronto for 130 to 180 parameters under the MOE's Drinking Water Surveillance Program. According to the Royal Commission's first interim report, there have been only rare exceedances of the Canadian drinking water guidelines for one or two substances in treated drinking water. However, there is insufficient information on the potential effects on human health of many chemicals and there are no health-related guidelines for many contaminants present in drinking water.

One serious concern relating to the environment of the greater Toronto waterfront is the impact of chemical contaminants on human health. Many trace contaminants present in the Greater Toronto Bioregion have the potential to increase the risk of cancer, birth defects, and genetic mutation, if there has been long-term exposure to them.

Persistent public concern about the quality of drinking water and the contamination of fish in the area is reflected in a 1985 MOE water quality survey of the Metro Toronto waterfront, summarized in Table 13.

Failure to comply with Provincial Water Quality Objectives was observed in the levels of cadmium, copper, iron, nickel, lead, zinc, lindane, heptachlor, aldrin/dieldrin, pentachlorophenol, DDT, and its metabolites. Violations were detected most frequently at STP outfalls, adjacent to lakefilling activity, and at rivermouths. Water quality was primarily dependent on the quantity of suspended sediment present because most contaminants were absorbed to it.

The 1989 report of the Great Lakes Water Quality Board showed that Lake Ontario was the most heavily affected of the Great Lakes, with the highest

Table 13. Toronto water quality 1985 - Maximum concentrations of metals, and trace organic compounds with percentage of samples detected in excess of Provincial Water Quality Objectives

Parameter	Cd ug/l		Cu ug/l		Fe ug/l		Ni ug/l		Pb ug/l		Zn ug/l		LINDANE ng/l		HEPTCHLR/ E.POX ng/l		ALD/DIEL ng/l		SUM OF DDT ng/l		PENTACHLR PHNL ng/l	
PWQO	0.2		5		300		25		25**		30		10		1		1		3		500	
Location	Max	%	Max	%	Max	%	Max	%	Max	%	Max	%	Max	%	Max	%	Max	%	Max	%	Max	%
2054 Mimico Creek	0.7	25	7	42	340	17	14	0	7	0	50	17	5	0	ND	0	ND	0	ND	0	ND	0
2072 Humber WPCP	0.8	58	20	75	970	83	30	33	4	0	80	50	6	0	ND	0	ND	0	ND	0	60	0
9053 Humber River	0.3	17	7	33	1400	25	6	0	6	0	16	0	2	0	1	0	ND	0	ND	0	ND	0
1536 Island FP	ND	0	5	0	44	0	3	0	8	0	3	0	ND	0	ND	0	ND	0	ND	0	343	0
1364 Inner Harbour	ND	0	35	30	260	0	2	0	4	0	16	0	10	0	2	10	ND	0	ND	0	ND	0
2017 Dredging	0.2	0	10	50	1070	100	3	0	13	0	18	0	5	0	1	0	ND	0	ND	0	ND	0
1379 Cherry Street	0.5	10	15	80	1200	100	7	0	18	0	28	0	89	30	6	10	11	50	ND	0	842	22
2020 Lower Don	0.2	0	41	100	1200	100	14	0	14	0	34	10	42	25	7	25	3	25	ND	0	144	0
1987 East Headland	ND	0	7	20	4300	80	4	0	93	20	22	20	ND	0	ND	0	1	0	5	10	ND	10
1419 Main WPCP	0.4	20	33	60	1400	20	13	0	15	0	100	20	2	0	2	10	ND	0	ND	0	285	0
2029 Harris FP	ND	0	4	0	28	0	2	0	7	0	4	0	ND	0	ND	0	ND	0	ND	0	117	0
1997 Control	0.3	10	6	10	22	0	2	0	6	0	5	0	1	0	ND	0	ND	0	ND	0	ND	0

PWQO - indicates Provincial Water Quality Objectives
MAX - indicates Maximum Concentration detected at that location in the 1985 survey
% - indicates Percentage of samples detected in excess of PWQO in the 1985 survey
Dredging - indicates a dredging location at the mouth of the Don River
Cherry St. - indicates a location in the Keating Channel at Cherry Street
E. Headland - indicates a lakefilling location near the Eastern Headland
* - indicates Guideline Only
** - indicates Variable Objective
ND - indicates Not Detected

Source: Metro Toronto Remedial Action Plan, Environmental Conditions and Problem Definition, 1988

mean concentrations of chlorobenzenes, PCBs, lindane, endrin, and p,p'-DDE (a degradation product of the pesticide DDT). Figure 12 shows the 1986 total distribution of PCBs in the waters of lakes Erie and Ontario respectively.

Trace metals and persistent organics have been found in the ambient water column of Lake Ontario and the rivers of the greater Toronto watershed. Although the levels of these chemicals are usually very low in water, bioaccumulation in animal tissue can occur, with concentrations increasing through the food chain to dangerous levels in animals at the top of the chain.

Biomagnification can increase contaminant levels in predator fish such as large trout and salmon by as much as a million times. Therefore, the consumption of fish is the single most common way people in the Greater Toronto Bioregion are exposed to contaminants. By eating one Lake Ontario predator fish at the top of the food chain, a person can consume more persistent organic contaminants, such as PCBs, than in a lifetime of drinking Lake Ontario water.

Regular monitoring of fish for contaminants, which has been carried out across the Toronto waterfront since 1974, shows that the level and type of contamination vary with location. Although young spottail shiners display year-to-year variations in levels of PCBs and some organochlorine pesticides, PCBs usually exceed the IJC guidelines for the protection of birds and animals.

It is generally accepted that the levels of contaminants in fish and wildlife serve as good indicators of the health of the ecosystem, and the effects of chemicals on these populations can be a warning of potential effects on humans. Although we do not know the full extent of the relationship between

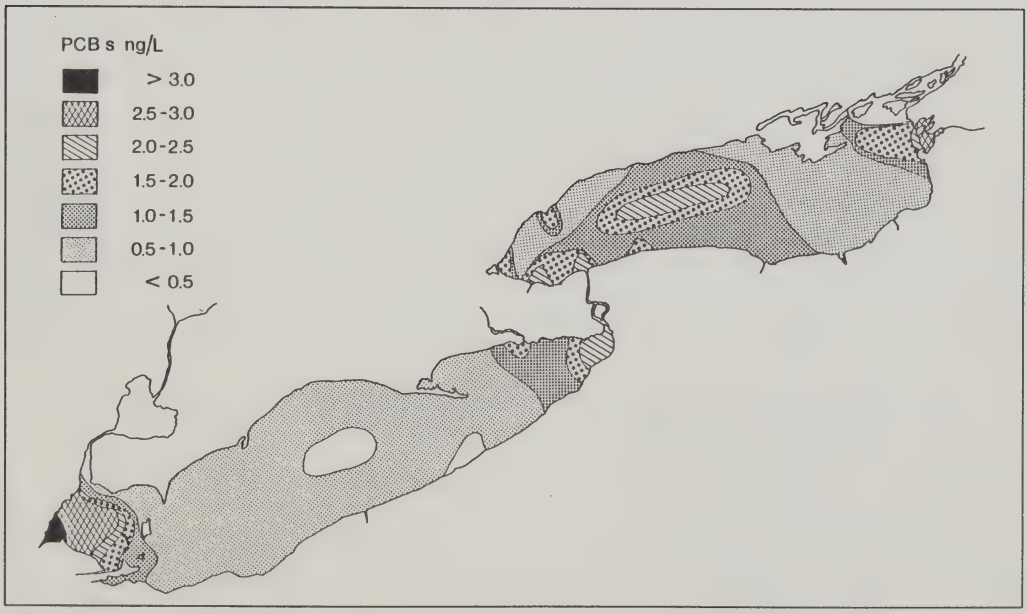
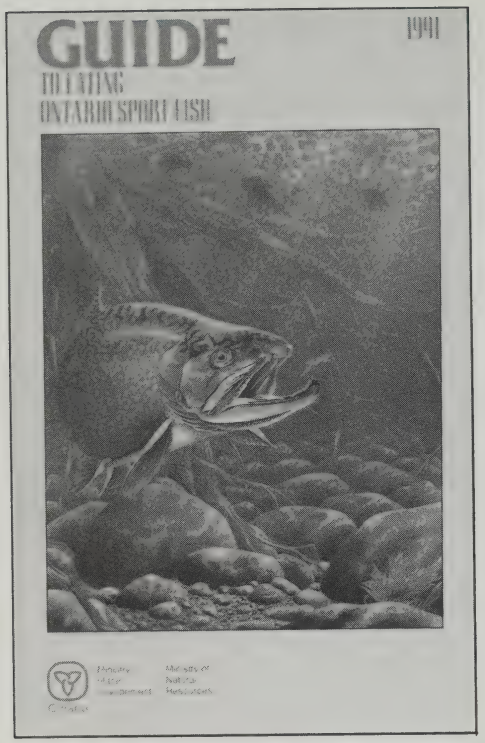


Figure 12. Spatial distribution of total PCB concentrations in water in lakes Erie and Ontario



Guide to eating sport fish in Ontario

human health and the consumption of toxic contaminants, we do know that persistent contaminants such as PCBs have resulted in reproductive problems, birth defects, and tumours in wildlife and fish.

A recent laboratory study by Daly et al. has shown that rats fed Lake Ontario salmon contaminated with PCBs, amongst other chemicals, developed behavioural problems, as did their offspring. Although it is difficult to extrapolate these effects to human health, recent studies by Jacobson et al. show that mothers who consumed relatively large amounts of Great Lakes fish contaminated with PCBs delivered smaller babies who later displayed diminished mental potential.

Because of the high level of contaminants in some fish, the Province of Ontario has issued fish advisories, warning that eating certain species may be a health hazard, and it has set guidelines for the consumption of various Lake Ontario sport fish. Although the health risks of consuming contaminated fish are not completely understood, the *Guide to Eating Ontario Sport Fish* recommends that children under 15 years of age and women of childbearing age not eat certain species and advises others to restrict their intake of these same species, depending on the size and location of the catch. The guide recommends restricted consumption of 13 fish species caught in GTB waters because of high levels of PCBs, pesticides, dioxin, mercury, and other metals. For example, in Bronte Creek, it recommends restrictions on eating chinook and coho salmon longer than 55 centimetres (22 inches), rainbow trout longer than 65 centimetres (25 inches), and brown trout longer than 35 centimetres (14 inches) because of organic contaminants such as PCBs or mirex at levels above federal consumption guidelines.

It should be noted that different jurisdictions use different standards and methods to define the amount of contamination present in fish. For example, Ontario analyses the fillet, while other jurisdictions analyse the whole fish.

In its *Fifth Biennial Report on Great Lakes Water Quality* (1990), the IJC asked the governments to re-evaluate the wisdom of fish-stocking programs that pose a health threat to animals and humans.

Clearly, a lot more work will be needed to meet one of the objectives of shoreline regeneration: ensuring that there are fish, edible regardless of size. Given the evidence that contaminants move from sediments into the food chain, contaminated fish are a warning of the condition of the water and sediment. If the shoreline is to be regenerated, the introduction of contaminates must cease or be drastically reduced, and already polluted sediment must be immobilized, buried or removed.

Sediment Quality

The Ministry of the Environment has recently released a series of reports on in-place pollutants and their impact on benthic invertebrates and sculpins. The studies show that uptake does occur, and biomagnification of some metals — accumulation in biota in excess of background levels — may be 10 times higher in tissue than in sediment and 100 times (two orders of magnitude) for some organic contaminants like PCBs and pesticides.

To assist in sound management of aquatic systems, the Ontario Ministry of the Environment has developed draft Sediment Quality Guidelines to supersede the Open Water Disposal Guidelines it promulgated in 1976.

The new draft guidelines were designed to be used in relation to sediment management. They include:

- determining fill quality for lakefilling;
- evaluating sediment quality as part of sediment monitoring programs;
- deciding on appropriate action for sediment clean-up in areas such as the Toronto harbour;
- evaluating dredged material for open-water disposal; and
- evaluating substrate material for the restoration of benthic habitat.

The new guidelines are based on biological effects and, therefore, are scientifically superior to the 1976 Open Water Disposal Guidelines. They have been developed to protect aquatic biological resources, particularly those most directly affected, namely the bottom-dwelling benthic species. The guidelines define three ecotoxic effects levels:

- No-Effect: no toxic effects have been observed on aquatic organisms. This is the level at which all biological resources will be protected and at which other water quality and use guidelines will be met.
- Lowest-Effect: this indicates a level of sediment contamination that can be tolerated by the majority of benthic organisms.
- Severe-Effect: this indicates the level at which pronounced disturbance of the sediment-dwelling community can be expected. It

is the sediment concentration of a compound that would be detrimental to the majority of benthic species.

Where it is not possible to derive a No-Effect value, an interim value based on the lower of the background or the Lowest-Effect level is proposed as a lower practical limit. In areas where local background levels of metals are above either the No-Effect level or the Lowest-Effect level, the guidelines stipulate that management decisions will be based on the local background level as the practical lower limit. In other words, where toxic thresholds are unclear, any material added should not make the water worse. Similarly, in areas of high natural organic matter, such as wetlands, the practical lower limit for nutrients will be based on local background levels. In areas influenced by atmospheric deposition of persistent organic compounds, the practical lower limit will be based on the Upper Great Lakes deep basin surface sediment concentration.

Impact of the Proposed Guidelines

Unfortunately, some people may assume that the new levels are so safe that we do not need to move towards zero discharge. But vast numbers of chemicals are not included in the data base. The remedial programs proposed by the MOE stipulate that, where in-place pollutants exceed the Lowest-Effect level, immediate steps should be taken to control point and non-point contaminant sources. Where the Severe-Effect level is exceeded, clean-up measures may be required in addition to source control.

The Work Group was assisted by MTRCA in estimating the impact of the new guidelines on material that would be acceptable for lakefill disposal. A review was completed of the nine largest sites that produced material for lakefill in 1990. It indicates that, employing the new MOE draft guidelines, three would continue to be acceptable; about half the material in three sources of fill would be rejected; and three would be largely rejected. The conclusion was that roughly 50 per cent of fill that qualified for open water disposal in 1990 would be rejected under the new guidelines.

Summary of Water and Sediment Quality Issues

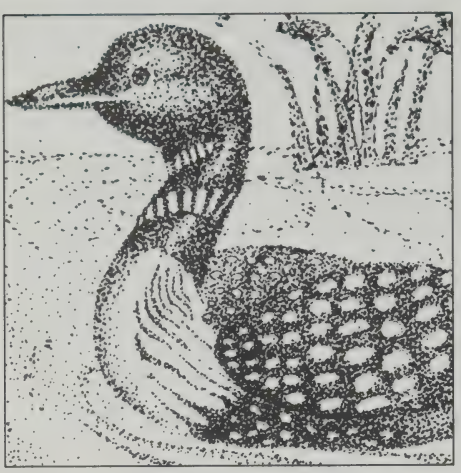
The success of shoreline regeneration will depend on the effectiveness of pollution abatement policies and strategies concerning upstream sources. While the adequacy of those strategies is an issue beyond the scope of this project, understanding the priority is of critical importance.

Lakefill and other shoreline modifications are not the largest cause of contamination in the area, but they are a significant source of local pollution, a situation that can be aggravated by the tendency of artificial headlands to interfere with the dispersion of contaminants. Furthermore, lakefilling is a discretionary activity and, therefore, a controllable source of contamination at a time when the IJC is calling on governments to adopt zero discharge of toxic substances.

Shoreline regeneration issues include the following questions, which are addressed in Chapter 4.

- Do we wish to continue to create lakefills with contaminated sediments, and if not, what are the options to avoid this problem?
- Are the guidelines for consumption of fish adequate to protect human health?
- Should the new MOE Draft Sediment Guidelines be adopted?

Habitat, Aquatic and Terrestrial



Habitat for plants and animals is an important building block in the complex natural system that supports our community. The quantity and diversity of natural habitat determine more than the birds and plants we see: they influence the microclimate in which we dwell, whether we feel dry or moist, or sense sun or shade, and how we feel about our quality of life. The smaller plants and trees that are part of natural habitat provide sights, smells, and colours that stimulate or soothe us and that can provide nourishment for our body as well as our senses. Protecting and enhancing habitat is of fundamental importance to our lives.

> The conservation of natural habitats also confers many environmental benefits: wetlands trap pollutants, wooded areas retard storm run-off, and streambank vegetation shades watercourses. Waterfront habitats are particularly valuable for many species of wildlife, including migrating birds, wintering waterfowl, and fish. (Royal Commission on the Future of the Toronto Waterfront, *Environment and Health*, 1988, 89)

Of the entire body of water, the shallow nearshore of Lake Ontario, including the estuaries and wetlands, provides the most abundant diversity of habitat and the greatest opportunity for utilization by aquatic biota. The most productive areas are those in which light reaches the bottom so that vegetation and aquatic microscopic organisms can grow. These, in turn, are a great source of food for some fish. The quantity and quality of vegetation and organisms are dependent on the composition of the lakebed materials, the depth of light penetration, the water currents, and water temperature. The shallow areas are necessary for the various life stages of a great variety of fish species because they offer areas in which they may spawn, incubate eggs, and nurture their young. Many of these areas are protected from sudden water temperature fluctuations that may be disastrous for fish at certain stages in the life cycle.

Evidence of Habitat Loss

The shores of the GTB were once home to a much wider variety of ducks, geese, herons, and other birds, as well as to reptiles and amphibians. The waters of Lake Ontario and the lower reaches of rivers teemed with a huge variety of fish including lake trout, herring, sturgeon, salmon, pike, and muskellunge. However, the habitat of the GTB has been degraded, a loss signalled by the

presence of fewer species, declines in the population of some species, and significant changes in the species in various locations on the shore.

The piping plover, a familiar resident of the beaches in the past, was declared an endangered species in Ontario in 1977. Many reptiles and amphibians inhabiting the shore zone are classified as rare, including the eastern spiny softshell turtle, as well as the Blanding's wood, stinkpot, and map turtles. Spawning grounds for fish have been lost: in the past century, 20 endemic species of fish have disappeared from the GTB waterfront, including such valuable sport fish as muskellunge, and species such as herring. The diversity of aquatic species in shallow areas is indicative of a healthy ecosystem. The loss of a healthy fish population — whether because they are physically displaced or contaminated or because the habitat necessary to their life stages has disappeared — greatly diminishes the entire water environment.

But it is not just animals and fish that have declined in numbers. Trees and plants have been displaced or severely restricted in numbers. Remnants of the Carolinian forest, which extended from the south-central United States to southwestern Ontario from Lake Erie to the Burlington-Toronto area, can be found on the shoreline of Lake Ontario and its river/stream tributaries. This ecological community, one of the great hardwood forests, has disappeared in Canada largely because of land clearing for agriculture and, to a lesser degree, human settlement. The remains of this forest can still be found, especially along the Burlington and Mississauga shoreline. Species such as shagbark hickory, red, black, bur, and white oak, butternut, walnut, black cherry, ash, and sassafras still exist; there are oak forests in Toronto's High Park — but they are isolated islands that have been virtually severed from the shoreline by extensive road and rail corridors — and important oak stands along the Oakville and Mississauga shoreline, where they act as a canopy for low-density residential communities.

West of Toronto, there is the more northern yellow birch, beech, white pine, and sugar maple forest ecosystem, which contains other major tree species such as white birch, white spruce, hemlock, and beech. At first, early settlers in Upper Canada were impressed by the magnificent stands of white pine they found in the colony; before long, however, they routinely cut down trees to build houses and factories in their growing communities and cities, to clear land for farms, and to meet other economic needs. By the end of the 19th century, the white pine forests were virtually destroyed. However, remnants still stand in Bronte Creek Provincial Park, in Petticoat Creek Conservation Area, in some of the Scarborough Bluffs ravines, and in the Rouge River valley.

The loss of both quantity and quality of habitat is the most significant cause of the decline of wildlife in the GTB. Therefore, re-establishing habitat is a very important, challenging task for those who wish to regenerate the shoreline.

Regeneration, as we have already seen, does not mean returning to the primitive forests of the 17th century but, rather, creating or supporting a healthy, diverse natural system for the future.

Causes of Habitat Loss

It is useful to weigh some of the causes of habitat loss in considering how to protect what remains, and how to restore or enhance habitat along the GTB shoreline. Factors affecting habitat include:

- forest clearing for agriculture and urban development;
- the loss of beaches and other connecting links between green spaces and different habitats;
- introduction of alien species, such as purple loosestrife and lamprey eels and zebra mussels, which stress and sometimes replace the native species;
- failure to consider habitat protection in development plans.

Shoreline modification has been part of the problem as well. Negative effects include the following:

- Silt escaping from lakefills covers the lake bottom spawning beds and discourages some food sources. Turbidity in the water blocks the transmission of light and inhibits the growth of plants and organisms that are an important part of the food web.
- Loss of shallow nearshore waters due to concrete seawalls, revetments, and other erosion control measures results in loss of shelter from cold water, spawning and feeding areas.
- Filling marshes and wetlands have similarly reduced the aquatic habitat.

At the same time, of course, shoreline modification has introduced some important new habitat. It is worth remembering that major landscape colonization and succession have occurred by accident on a lakefill site that extends five kilometres (three miles) into Lake Ontario. Tommy Thompson Park is indicative of nature's ability, even in close proximity to a major city, to renew itself and become biologically productive. MTRCA's Aquatic Park Environmental Study of the Spit,which covered 1978 to 1982, identified 11 major plant community types on the site. Two hundred and seventy-eight species were recorded, of which 14 are nationally, provincially, and/or regionally rare, and seven are classed as regionally uncommon.

All these plant species are experiencing successional change with obvious increases in the number of woody stemmed shrubs and trees. The vegetation comes from the nearby Toronto Islands and from the non-native species and

Figure 13: Number of fish species found — Toronto waterfront fish collections 1989

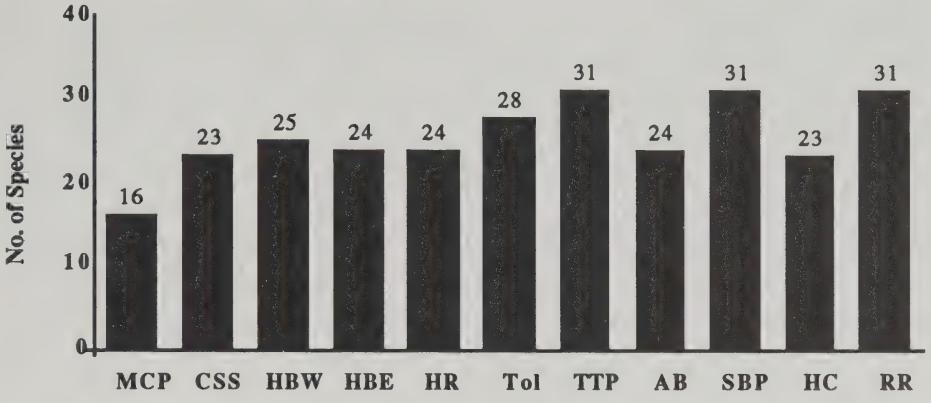
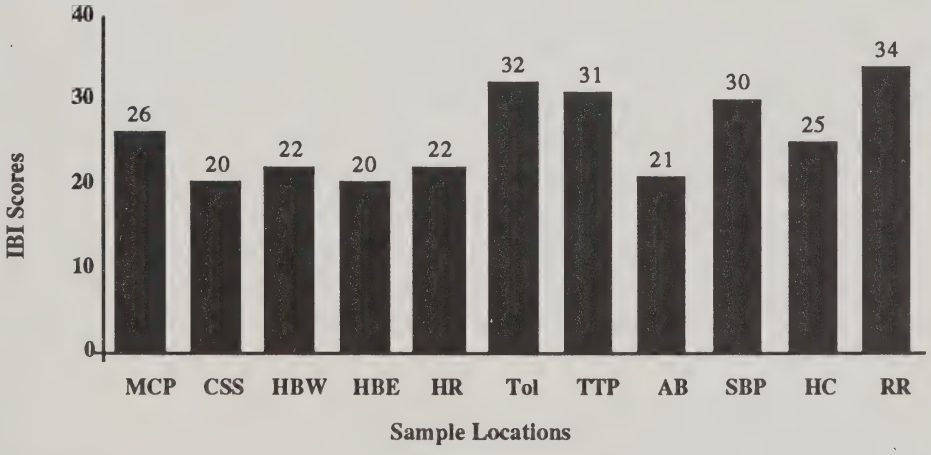


Figure 14: Relative health of fish communities—Toronto waterfront fish collections 1989



Source: I. Buchanan, *Presentation for Royal Commission on the Future of the Toronto Waterfront*, 1991.

Note:
MCP: Marie Curtis Park
CSS: Colonel Samuel Smith
HBW: Humber Bay West
HBE: Humber Bay East
HR: Humber River
Tol: Toronto Islands
TTP: Tommy Thompson Park
AB: Ashbridge's Bay
SBP: Scarborough Bluffer's Park
HC: Highland Creek
RR: Rouge River

comes from the nearby Toronto Islands and from the non-native species and garden plants in Metropolitan Toronto.

Lakefilling has also had some positive effects on fish species; in fact, some lakefilling in the past was rationalized on the basis that existing habitats were often biologically less productive than the new environments would be. For example, aquatic conditions before construction revealed that Bluffer's Park was a very active erosion and sediment transport area, with little bottom vegetation. Fish populations were very low and the area was assumed to have minimal spawning potential. Following construction, surveys have shown an increase in quantity and species of fish.MTRCA has now determined lakefill peninsular and reef construction would be beneficial in enhancing fish habitat creation.

For the Bluffer's Park lagoons, the MTRCA 1983-1984 Lake Ontario Waterfront Electrofishing Survey showed that alewife, gizzard shad, and white sucker form the bulk of the coarse fish present in the lake and that, in the fall, large concentrations of brown trout are present at various locations, as are yellow perch. In 1989, walleye were found and, in 1990, the most significant discovery near Bluffer's outer breakwall was a group of lake trout in spawning condition.

While the same coarse species are present in Tommy Thompson Park, there are large populations of northern pike in the shallow lagoon areas in the summer. Yellow perch, largemouth bass, white perch, white bass, round whitefish, black crappies, pumpkinseeds, and American eels are also abundant. Their presence indicates what habitat and forage is available and shows that thermal regimes in the area are stable. The largest total catch in the study came from the Humber Bay Park lakefill while the Rouge Marsh had the highest diversity of species (27). Figure 13 shows the number of species found in various locations in the 1989 survey.

The Integrated Biota Index (IBI) is an indicator number employed by biologists, based on a range of factors, to assess three characteristics of every fish community: species composition, trophic composition, and health and abundance of fish. The IBI gives a relative score for each location; the score indicating a less degraded area. A score falling between 40 and 45 was considered very good; 34 to 39 good, 28 to 33 fair, 19 to 27 poor, and 0 to 18 very poor.

Figure 14 shows the IBI scores for 11 Metro Toronto locations. No location was evaluated as "very good." Four sites, Toronto Islands, Tommy Thompson Park, Bluffer's Park and Rouge River Mouth, were considered "good."

Lessons from Habitat Loss

There is very little evidence that anyone set out to destroy habitat along the GTB shore. While there was mention of mosquitoes and health concerns in connection with the decision to fill the Ashbridge's Bay Marsh, the primary motive

was to create land for industry. It would appear that initiatives that damaged or destroyed habitat accidentally were treated as "collateral damage" in the course of striving forsome other objective. This begs the question of how our planning and approval mechanisms failed to protect natural values, including habitat.

Three causes are apparent:

- The Planning Act is oriented to development, and not well suited to protecting natural values or the environment.
- There are no goals or objectives for habitat or wildlife on the GTB shore.
- No consideration has been given to cumulative effects — the accumulated results of many incremental stresses on the environment have not been considered in planning and environmental assessment. The orientation is to each project in isolation from the rest of the natural environment. Much has been lost, not from one traumatic event but from "a thousand pin pricks".

The problems of integrating environmental priorities and the Planning Act are difficult and complex. The Royal Commission's publication *Planning for Sustainability* concluded:

> The current inadequacy of land-use planning processes to protect and improve ecosystem health results from many inter-related factors. They include: limited or ineffective use of the provisions of the Planning Act; the act's own limitations; lack of provincial leadership; and lack of clarity in the relationships between the Planning Act and the Environmental Assessment Act. (Royal Commission on the Future of the Toronto Waterfront, *Planning for Sustainability*, 1991, 60)

Fortunately it is not necessary for this knot to unravel before action is taken. A number of options and recommendations related to habitat protection are discussed in Chapter 4.

Strategic Plan for Ontario Fisheries (SPOF)

The Strategic Plan for Ontario Fisheries (SPOF) was developed in the mid-1970s by a federal-provincial task force. The refined 1981 Lake Ontario Tactical Fisheries Plan dealt specifically with issues of rehabilitation and dredging. Its objectives include:

> Rehabilitate protected embayment and estuary habitats to act as biological reservoirs and to provide near-urban warm-water fishing opportunities ... Conduct ... [an interdisciplinary research program] focusing on the creation of artificial warm-water fish habitat, notably marsh creation at landfill sites (e.g., Aquatic Park) ...

> Promote construction of offshore islands as opposed to 'spits' (landfills with causeways to allow pollution dilution) in sediment basins (non-critical fish habitat) in the Western Basin of Lake Ontario if proper construction practices are observed and if above studies demonstrate viable warm-water fish habitat can be created.

The Lake Ontario Tactical Fisheries Plan addresses dredging and disposal directly:

> Minimize negative aquatic impacts due to landfilling, dredging and disposal operations.... In pre-operational impact assessment studies use research information to incorporate beneficial features.

Implicit in these objectives for enhancing aquatic habitats is the establishment of management programs as an integral part of the disposal process — and not as an additional remedial measure after disposal has been completed.

An issue arising from these objectives is our technical ability to create habitat for specific fish. Just as it takes more than cattails to make a wetland, it takes more than water and good intentions to create habitat. Some failures in the past raise caution flags in the face of broad statements. (Further comment on this subject can be found in Chapter 4.)

Habitat Creation Issues

A difficult issue for the Work Group was the priority that should be given to enhancing the availability of sport fish. Certainly, there are attractive recreational and economic benefits from stimulating the production of fish suitable for sport fishing. Unfortunately, the areas proposed were chosen because of their isolation from the cold upwellings from Lake Ontario. The proposed location for pike enhancement is the confined disposal cell for contaminated dredge sediments on the Leslie Street Spit. While the plan calls for special capping (a clay seal over the contaminated sediment) of the cell, the cell is surrounded by contaminated sediment, an inauspicious location for producing healthy fish. A second area mentioned for enhanced production is in (contaminated) embayments around the marina/boat club parks such as Bluffer's Park— which raises similar concerns. No final conclusions have been drawn by the Work Group because there is insufficient information about alternative initiatives.

From time to time, projects are approved that damage or destroy habitat. Presumably it is decided that economic and social benefits overwhelm environmental damage, and questions of replacement arise. This is particularly true of fish habitat, about which the federal Department of Fisheries and Oceans has a "no net loss" (of habitat) policy. Such a situation gives rise to questions of how offsetting benefits are defined.

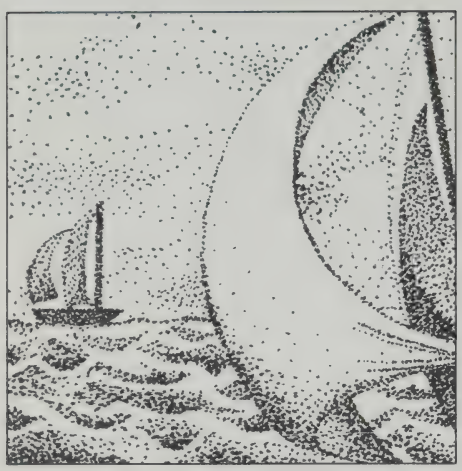
This and other habitat issues are discussed in Chapter 4, including how habitat enhancement goals should be set, how they should fit into the planning process, and how they could be funded.

Summary of Habitat Issues

A natural shoreline is a rich and vital habitat. Loss of both its quantity and quality has been the leading cause of wildlife decline, in both terrestrial and aquatic species, in the GTB. Shoreline modification has been a significant factor in that destruction and, potentially, could be an element in restoring wildlife habitat.

Clearly, our planning system has failed to protect habitat and natural values. Weaknesses in the Planning Act, a lack of habitat goals and objectives, and cumulative effects of many small events have caused accidental loss of habitat.

Quality of Life



The shoreline has been discussed in terms of its contribution to the economy, waste disposal, and water for drinking and bathing, as well as wildlife habitat. Perhaps the most important aspect of the shoreline, from a human perspective, is its contribution to the quality of life. This benefit is often hard to quantify because it includes such subjective matters as beauty, relaxation, recreation, sport, excitement, and comfort. Changes on the shoreline put some of these benefits at risk and raise a variety of concerns and issues.

Aesthetic Concerns

Shoreline areas — the interface between land and water — are dynamic landscapes that can have high aesthetic quality. It is important to find ways to protect the existing major natural shoreline east of Toronto. At the same time, there is little remaining of the natural Lake Ontario shoreline west of Toronto: scenic landscape features such as rockface outcrops, beaches and sand dunes, wetlands, and Carolinian tree stands have been reduced or virtually eliminated.

Shoreline stabilization measures — including the construction of breakwaters, groynes, jetties, revetments, barrier islands, sea walls, and armoured headlands — have led to hard, artificial structures, solutions that detract from the natural landscape with their inappropriate appearance and design. The history of shoreline stabilization shows that engineering problems may have been resolved, but the character of the landscape has suffered.

Shoreline areas are attractive because of the natural amenities offered by water: people want to enjoy attractive, clean, safe, and pleasant environments.

In the past, redesigned or rehabilitated shorelines have generally been landscaped with manicured lawns, large, nursery-grown trees, and occasional shrubs. This so-called lollipop approach has meant a loss of native vegetative communities due to plantings of hybrid nursery stock and exotic trees and shrubs. The results have been pleasant but far from outstanding landscapes; these monocultures of grass have meant a loss of the ecological diversity necessary for wildlife habitats and a similar aesthetic loss of the rich complexity in plant species and land forms.

Some people prefer the tidy, formal landscape design, while others prefer a less controlled and more natural scheme. Examples of the latter are found in Tommy Thompson Park, and on the western beaches of the Toronto Islands,

where natural plant succession created a much-loved urban wilderness that gives people a sense of freedom and exhilaration as they walk through its changing spaces and views.

In managing shoreline, the issue is where to retain the formal park approach, where to encourage naturalized planting and wildlife habitat, and where to have grass meadows and vales that can be used for picnicking and games. There are many options, but well thought-out landscape plans are needed to relate ecological zones to recreational uses.

It is a given that lakefill areas change the waterfront and it can certainly be argued — and has been, in this report and elsewhere — that change can be better than existing conditions. But not all lakefilling improves shoreline and, in some cases, it can be actively harmful. The negative implications of lakefill with respect to aesthetics include:

- disturbing open water views;
- altering natural shoreline configurations and features such as beaches and bluffs;
- the uneven quality of lakefill design;
- incompatible development on or adjacent to fill (e.g., buildings, marina structures, boat and vehicular parking/storage facilities);
- loss of fill and creation of turbidity during and after construction;
- ongoing water quality problems due to entrapped debris and sediments and impaired dispersion of local effluent;
- obliteration of the water's surface as wetlands are filled in;
- blocking views if tree growth is proposed or allowed to develop.

The aesthetics of the shoreline will change in time, as the lakefill landscape matures: newly established trees will grow, conditions at the water's edge will change because of siltation and fluctuating water levels, and wildlife may multiply. (Some may become nuisances, as have the once-loved Canada geese and seagulls.) Shallow lagoons may become mud flats, which are of great benefit to wildlife, but not considered visually appealing.

Diversity

Managing shoreline regeneration means recognizing ecological diversity and developing landscapes that will allow colonization and natural succession and, at the same time, meet the immediate and future needs of people. Environments dominated by a single, or very few, species are exceptionally vulnerable to disease, pests, and stress. For example, communities in which elm trees dominated the landscape were hit hard by Dutch elm disease; those

without resources to save individual trees were left bare. Moreover, the concentration of elm in some areas probably accelerated the disaster by making it easier for the disease to spread.

By contrast, a diverse regional ecology marked by a wide variety of species is more resilient and better able to deal with such problems because it has not "put all its eggs in one basket". Given that it is an ecological virtue, plans and designs for shoreline modification should support diversity.

Different scenic landscapes require different strategies; for example, the Burlington shale outcrops at Burlington need protection from the very wave action essential to maintaining the steep Scarborough Bluffs. In order to protect them, a way must be devised to minimize erosion. On the other hand, protecting the Scarborough Bluffs may, over time, eliminate their rugged slopes and the cathedral-like quality that has made them one of Toronto's most cherished landscapes.

The sad fact is that, however scenic, sections of the bluffs will continue to erode until they cease to exist and are merely vegetated slopes. This is a case where two realities collide: on the one hand, the bluffs are magnificent and should be a source of awe and pleasure for generations to come. Therefore, any solutions should consider aesthetic considerations as well as protection of property.

The Cultural Landscape

The shoreline of Lake Ontario holds in it the history of urbanization in Canada's largest metropolitan area. Communities were founded around the lakeshore's rivermouths and harbours, going back centuries. In time, people built their homes, their factories, their offices, and their public institutions on or close to the shoreline.

Successive communities have left evidence of their presence: there are ruins from forts, native settlements, industries, homes, ship channels, and harbours. A few historic buildings and landscapes remain, either as remnants of the past or in renewed glory. The Sunnyside Bathing Pavilion, for example, recalls the boardwalk of the 1930s, before the Queen Elizabeth Way was constructed nearby. The Palais Royale and Gairloch Gardens are there, reminders of a less hectic time.

Waterfront port areas are rich in industrial heritage and include pier and wharf structures, railway facilities, grain silos and elevators, cranes, lifts, and bridges. Collectively, they express a part of history that is too easily forgotten: factories where people toiled, mills where wheat was collected for shipment, railways that bound the country together. Unfortunately, inadequate planning and protection led to the destruction of many of these facilities. However, the Lake Ontario shoreline still has prime examples of industry, past and present,

that could provide a substantial basis for interpretation and adaptive re-use. The harbours at Oakville, Port Credit, and Whitby have the potential to become distinctive waterfront communities, but require careful planning and design before shoreline plans are developed.

Recreation, Parks, and Open Spaces: Meeting Leisure Needs

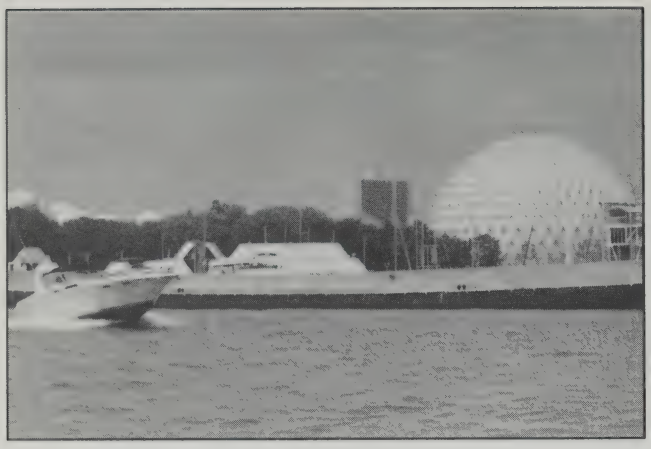
In his book, *Remembering the Don*, the revered naturalist Charles Sauriol records his memory of a man and his family who walked to the Don River with the sounds of distant cars passing every few seconds along Don Mills Road, fleeing the

> ... city towards the lake, as though the former was in the grip of a pestilence. But there was no such escape for him: a small salary, a small flat, and three small children. There would be no lake for them. That was his lot. [One day, the man] opened his morning paper and read of plans for the conservation of the valley. He set the paper down, went to a cupboard, removed a jar of black raspberry jam, which came from the valley, smeared his toast with it and began to read carefully every line. "Don Valley Authority", "Department of Planning and Development", "Conservation Association", "Green Belt". Every word stood out in his mind backed by reality. "Greenbelt", he muttered, "It's more of a Life Belt, that is what it has been to me. I wonder for how many more?" (C. Sauriol, *Remembering the Don,* 1981, 26)

Early residents would have difficulty finding enough raspberries for jam today: the Don Valley is plugged with road and rail arteries and with other uses that have virtually eliminated the impressive natural forest stands that were still there 40 years ago, remnants of which can be found today on the unexcavated, upland portions of the former Toronto Brickworks site.

The Lake Ontario shoreline is, indeed, part of a psychological life belt that has its limitations and is exhaustible. The early settlers' notions of a landscape from which resources could be extracted forever — an idea that, like the forests, existed until 40 years ago — is now recognized as naive and unrealistic. It has left behind a legacy of trees that were not replaced by natural growth, wildlife habitats that have been irrevocably destroyed, fish stocks that were depleted, species that have disappeared, and water of severely diminished quality.

For many people, the shoreline exerts an almost mysterious pull: it still offers a sense of country in our towns and cities. A walk with the dog along the water's edge, skipping stones over the lake's surface, finding a unique piece of driftwood, riding a bicycle on a trail through tall grass, or fishing off some rocks or a pier: these are just some of the ways people use the waterfront — if they can get to it. This lineal greenbelt lifeline is a precious piece of our natural and cultural heritage and, like all of our environment, does not belong to us,



Boating by Ontario Place

but has only been entrusted temporarily to our care.

Enhancing access to the waterfront is closely related to providing new water and land recreation opportunities, which are often created through lakefilling. Lakefilling has also generated new parks and habitats for fish, plants, animals, and birds. While marinas, boat launching ramps, and transient docking areas are valuable for recreation, they may also result in another set of environmental problems. In considering new facilities on Toronto's shoreline — where there is such a demand for recreation, parks, and open spaces — standards of appropriateness, scale, and location become critical.

Boating

Since the time the Simcoes arrived in what was to become Toronto, people have been fascinated with the waterfront. Today, a growing population, changed demographics, and an affluent society have altered recreational expectations. The most visible result has been a substantial increase in the amount of space reserved for activities such as boating, parking, picnicking, and walking.

Table 14. Boat mooring capacity in the Greater Toronto Bioregion

	Current (Wet Berths)	Planned (Wet Berths)
Lakefront Promenade Park	640	0
Colonel Samuel Smith Waterfront Area	0	520
Ontario Place	350	0
Outer Harbour Marina	380	1,200
Ashbridge's Bay	320	0
Humber Bay West	590	100
Bluffer's Park	1,100	0
East Point Park	0	600
Total	3,380	2,420

Source: MTRCA staff, 1991

New marina and boat-docking spaces have been developed on land created through lakefilling, and they constitute the largest single recreational use of such land on the GTB shoreline.

This was inevitable, given the few options to expand marina facilities in and near Metro: all the natural harbours, Bronte Creek and Frenchman's Bay, and rivermouths such as those at Sixteen Mile Creek and the Credit River, have been totally developed. These estuary areas represent some of the most important and fragile waterfront ecosystems; but to accommodate boating demands, they had to be dredged and, in being dredged, were damaged.

Providing wet and dry berths to meet projected demand for marinas has frequently been used to justify lakefill development. In the Greater Toronto Bioregion, there are 24 marinas and 47 yacht clubs with a total of 11,176 wet berths; dry berths are offered by nine marinas and 30 yacht clubs with a total of 2,811 spaces. Current and proposed lakefill has allowed marinas and clubs to develop at eight sites accommodating approximately 2,420 berths. This will bring the current and planned capacities at lakefill sites to the numbers detailed in Table 14.

Until the economic downturn in 1990, the apparent demand for wet boating berths was expected to increase, with emphasis on larger boats and the need for berths for power boats, related shore-based facilities, and transient and day-trip docking.

The question of subsidy of boat berths has been discussed in our review of Colonel Samuel Smith Park. There can be no doubt of the popularity of boating on the waterfront. However, the issue is the appropriate role for government in providing benefits.

Boardsailing

There has been a dramatic increase in boardsailing in the past ten years. The sport owes its popularity to its low cost, the ease of transporting equipment from one location to another, the length of the season in which it can be enjoyed, and the modest shore-based facilities required.

The Cherry Beach area in the Outer Harbour created by the Leslie Street Spit, has become a favourite location because lakefill has created a protected embayment. The demand for new locations along the entire waterfront can be expected to continue, with emphasis on the need for parking areas and clubhouse/storage/safety facilities.

Rowing/Canoeing/Kayaking

Both Metro's 1967 Waterfront Plan and the recent bid for the 1996 Olympics mentioned the lack of a 2,000-metre (2,200-yard) regatta course. The greater Toronto waterfront has internationally recognized rowing, canoeing, and

Sunnyside Beach, 1911

kayaking clubs, but the only rowing facility is the 900-metre (1,000-yard) course at the Toronto Islands. These water sports have community-based recreation and competitive clubs that, although small, are growing rapidly. There are no natural river courses or protected lakes, of the scale required, but a regatta course could be developed as part of a lakefill project. (Options for considering such projects are discussed in Chapter 4.)

Water-based Recreation

Swimming has always been a popular form of recreation. The fact that pollution results in beach closings in and around Toronto each year places an especially heavy burden on families with low incomes — the ones with the fewest recreation choices. Beaches are an important feature of the Lake Ontario shoreline and should be available to people who are entitled to swim without being endangered by contaminated or hazardous materials and the risk of disease or illness. Stagnant embayments created by lakefilling, which prevents the flushing action of clean water, are part of the problem and exist at most lakefill sites.

The western beaches in the City of Toronto are particularly vulnerable because of the large number of sewer outfalls and the discharge from the Humber River. While a 1985 MTRCA survey showed that swimming was one of the most popular leisure activities for users of waterfront parks, it is often impossible because of a lack of open beaches and clean water.

Fishing

Thanks, in part, to restocking programs, fishing has become a major form of recreation. In developing lakefill sites, rock rubble has been placed in the water, thereby changing its depth and temperature; new vegetative communities have appeared and, with them, associated insect populations and the fish that feed on them. Major species that have either been re-established or attracted include brown trout, pike, walleye, and bass. The increase in salmon and the resultant sport fishing have had a significant impact on the design of shoreline and lakefill sites to accommodate boat-launching ramps and provide substantial land areas for car/trailer parking.

The popularity of fishing has led to conflicts in areas such as Bluffer's Park, where non-fishing recreational visitors have found parking difficult, if not impossible, at certain times. Port Credit Harbour has developed as a major sport fishing centre and, therefore, has had to accommodate large numbers of cars and trailers as well as providing an adequate number of boat-launching ramps. As the water quality of Lake Ontario improves and fishing habitats are either created or enhanced, interest in fishing can be expected to keep growing. More fishing docks and piers will mean pleasure for a great number of urban dwellers who want to spend a simple day at the water's edge.

But fishing on the shoreline raises the important issue of whether it is appropriate to encourage and enhance the opportunities to catch contaminated fish. Should the priority be to clean up the contaminated environment first, then stimulate fishing?

It is argued that information is available to the public concerning the size and quantities of fish considered safe for consumption. (The section in this chapter titled "Water and Sediment Quality" discusses recent challenges to the criteria for "safe consumption".) While fishing is not the same as eating fish, it is hard to believe that everyone reads, believes, and acts on the guidelines, or that all fishers will forego the temptation to eat large, and apparently healthy, fish.

A second fishing issue is the priority given to stocking the lake with species that must be artificially introduced. While there is no doubt that tourism and recreational benefits have resulted from the presence of Pacific salmon, it is reasonable to ask how much this activity has diverted attention and energy from efforts to clean up, protect, and restore the habitat of native self-sufficient species.

Accessibility

Historically, access to the waterfront has been limited for members of the public because land has been in the hands of private owners who used it for residential, industrial, institutional, and commercial purposes. Also, there are many publicly owned properties that are inaccessible, including water and sewage

treatment plants and electrical generating stations. In municipalities where waterfront land is owned by a public agency such as a board of harbour commissioners, access has generally been restricted to active port operation areas.

As port activities increased, waterfront areas were extensively developed, in turn, for industrial uses that integrated shipping activities with railways and highways. The barriers created by these corridors, combined with the need for cargo security, made the shoreline — one of our greatest natural resources — psychologically and physically inaccessible.

In the more suburban and rural shoreline areas, the sale of waterfront lots for private residential development has effectively sealed off the water from the public except at municipal and provincial parks and conservation authority lands.

Ironically, the fact that private and public landowners, especially in the Scarborough, Oakville, and Burlington areas, have to deal with severe erosion has improved public access: remedial actions to control the harm caused by wave action have included property acquisition and the development of various erosion control structures at such places as the Scarborough Bluffs and Burlington Beach. This has provided new opportunities for public access and the development of recreation facilities.

Three types of access have been considered in planning shoreline areas. The first is point access: it maintains public and private ownership of shoreline, but introduces new public access and recreation facilities in other places; lakefill has been one of the most important techniques used to create new public recreation land for point access.

The second type is linear access, in which existing public roads provide access at intervals to the waterfront. Because it requires existing or built waterfront land, this kind of access can be implemented with or without lakefill.

The third type is acquired access, which is based on a policy of purchasing property to create a continuous strip of publicly owned waterfront land. Acquiring waterfront lots, through direct purchase or expropriation, is a technique sometimes used by agencies to ensure continuous public access to a large public resource. This may include purchasing or expropriating portions of land or lakefilling and erosion control measures creating new lakeshore, and may permit property owners who have sufficient lot depth to continue their occupancy while providing access to meet the needs of the public. The trail system at the base of the Scarborough Bluffs is a good example of this. However, any consideration of continuous acquisition of lakefront must consider whether this is truly necessary and how the responsibilities for safety, sanitation, policing, and maintenance will be managed and financed. In providing access, it is necessary to consider the modes of transportation people will use to get to the lakeshore — on land by public transportation (GO trains, buses, and street-

cars), school buses, automobiles, bicycles, and foot. Water options include ferries, water taxis, pleasure craft (sail, power, and various non-motorized boats), and cargo ships. Air accessibility includes both land and sea planes as well as helicopters. Lakefill areas have been developed extensively to accommodate each of these modes of transportation and sometimes the result has sterilized the shoreline. For example, the Toronto Island Airport has sealed off the water's edge on large parts of Hanlan's Point while, in other areas, the priority given to cars has resulted in large parking lots that are out of scale with surrounding parklands and blight the landscape. Bicycle paths have invariably been squeezed between road surfaces and curbs, creating unpleasant and dangerous conditions, especially in the Central Waterfront Area.

The lack of an identifiable, agreeable, continuous, clean, safe, and green waterfront pedestrian system has been identified as a major planning issue and has been addressed in previous Royal Commission reports. The Commission's recommendation of a waterfront trail from Burlington to Newcastle, connecting access points to the waterfront, is a good guide to shoreline regeneration measures that will be required if the shoreline is to become accessible.

Perceptual Accessibility

This aspect of accessibility involves visual and psychological considerations. Many communities have carried out visual studies as a basis for ensuring continued views of the water; they have defined significant vista points, prominent landmarks, and view corridors. Assessments have also been made of scenic quality and preferences, which relate public attitudes and perceptions to priorities for preserving and enhancing scenic points.

Shoreline areas are particularly vulnerable to visual change because their high land values engender demands for redevelopment. Intensification of uses has led to visual conflicts: large projects such as building developments and marina complexes block views of the water's edge. Toronto's central waterfront development, and the proposals for development of Etobicoke's lakefront, indicate the need to protect scenic corridors and vista points to the waterfront.

Lakefill itself can create visual problems by extending land into the water and placing the shoreline in a more remote and visually inaccessible location. (Visiting today's Fort York, it is hard to imagine what it must have been like when it actually stood guard on the shores of the lake.) Removing the shore's edge from view turns lakefill areas into land extensions that invariably destroy the shoreline and the dynamics of water and land interactions.

Psychological accessibility refers to the degree to which a sense of openness and belonging is engendered in people. Waterfront areas should make people feel they are not trespassing, they are safe and secure, and are visiting places that have distinct identities. At present, there is often a feeling of ambiguity about defining public, semi-public, private, and semi-private spaces. This is

Harbour Square Park hidden by condominiums

especially noticeable around Harbour Square Park, a city waterfront park designed primarily to serve as a circulation and gathering space for the Toronto Island ferries. But the park has taken on the character of a forecourt for the condominiums and the hotel that frame it, thus weakening its potential as a public waterfront open space.

Condominium projects adjacent to lakefills can create problems if their edges are not carefully designed to prevent problems such as intrusions on privacy, vandalism, loitering, and trespassing. Lakefill proposals for regional recreation facilities located in front of existing community developments can create traffic, noise, and related people problems. The conflicts that result can create a loss of psychological accessibility because people feel uncomfortable visiting and using an area or facility. Therefore, lakefill proposals must be carefully integrated with community planning goals and objectives to ensure they are appropriate for both nearby residents and visitors.

Economic Accessibility

As the cost of waterfront real estate increases, the ability to purchase land for public park and recreation purposes tends either to diminish or to be phased over long periods. If the waterfront is meant to serve more than the economically advantaged, the need to increase the number of parks and recreation spaces must be recognized as a priority.

Creating new open space through lakefilling is economically advantageous: a review of several recent projects indicates that significant new open space areas have been created and developed for approximately $445,000 per hectare ($180,000 per acre). It is important to note that these figures do not include environmental costs or the cost of ongoing repair and headland maintenance.

Land values vary considerably over the study area but estimates for Mississauga are $667,000 per hectare ($270,000 per acre), and about $ 7.4 million per hectare ($3 million per acre) in the central Toronto area. Clearly, land acquired for parks and recreation uses will be expensive and other techniques

of acquiring use of it — such as transferring ownership, long-term leases, negotiations of easements and rights-of-way — are possible options.

While additional lakefill and shoreline regeneration may seem appealing, they should not be seen as an option to satisfy municipal open space needs. Guidelines are needed for establishing methods for allocating open space areas throughout the GTB. Arbitrary open space allocations such as 12 hectares (five acres) per 1,000 people may not reflect the ecological context of a particular landscape — its woodlot areas, wetlands, and sensitive wildlife habitat. When municipalities accept cash in lieu of park space, they run the risk of open space deficiencies in the future.

Access to the shoreline carries responsibilities with it and the creation and maintenance of it must be integrated with other shoreline regeneration goals. An access area must be safe and its use limited to those purposes that are compatible with the neighbouring community. Abuses must be minimized and public lands maintained in good order. Noisy and damaging activities, which infringe on the quiet enjoyment of the rights of adjacent landowners, must be controlled, as must litter and other unattractive aspects of public use. In addition, it must be understood that there are public uses of lands, such as habitat and species enhancement, that may require sanctuaries, just as there are vulnerable public utilities that must maintain security arrangements. These needs place reasonable limits on access.

Summary of Quality of Life

The shoreline of the Greater Toronto Bioregion has great potential to contribute more to the quality of life of the region's residents. Two issues are of particular importance: first, the lack of imaginative and natural landscapes has led to the loss of aesthetic pleasure; second, there is potential for improved access, including physical access (being able to get there), perceptual access (the feeling that you have the right to be there once you have arrived), and economic access (being able to afford to stay and enjoy). These issues are discussed in Chapter 4.

CHAPTER 3

THE REGULATORY FRAMEWORK

Which levels of government have responsibility for the issues identified in this report? What legal tools do they use? Why do governments spend so much time approving specific projects, and so little time doing ecosystem planning? How do governments in other provinces and states deal with shoreline issues? How could the Province of Ontario better deal with them?

Jurisdiction: Who's in Charge?

> Bureaucratic turf wars are hell on species... It's hard enough to delineate human activity in meaningful categories, but in the biological realm, these partitions don't make sense. Boundaries defined by nations, provinces, counties or municipalities for the conduct of human affairs are of no relevance to the confines of air, watersheds, mountain ranges, ecosystems or distribution of plants and animals. (David Suzuki, *The Toronto Star*, 20 April 1991)

Many branches in all levels of government have responsibility for planning, approving, and monitoring projects along the Lake Ontario shoreline between Burlington and Newcastle. The federal and provincial governments are involved, both through their constitutional jurisdiction and in their capacity as landowners. Regional and municipal governments have local planning responsibilities, and through ownership, they control parks, water and sewage treatment plants, and other lakefront facilities.

Conservation authorities have responsibility for erosion and flood control and some of them own or manage waterfront parks and marinas. Moreover, governments often establish semi-autonomous bodies with responsibility for certain activities located along the waterfront; for example, the federal government created the Harbourfront Corporation, the Board of Toronto Harbour Commissioners, and the Oshawa Harbour Commission, while the Province of Ontario established Ontario Hydro and Ontario Place.

The Federal Government

The division of powers between various levels of government in Canada was first established in 1867. According to our constitution, the federal government has exclusive authority over certain aspects of shoreline-related activity, such as navigation, shipping, and fisheries. Responsibility for navigation and shipping rests with the Department of Transportation, while fisheries come under the Department of Fisheries and Oceans. In recent years, the federal Minister of the Environment has been given responsibility for assessing federal projects that affect the environment, and for preventing discharges of certain contaminants. The federal government is responsible for all trans-boundary waters, and for international treaties.

The Boundary Waters Treaty of 1909 and the Great Lakes Water Quality Agreement affect the Lake Ontario shoreline. The International Joint

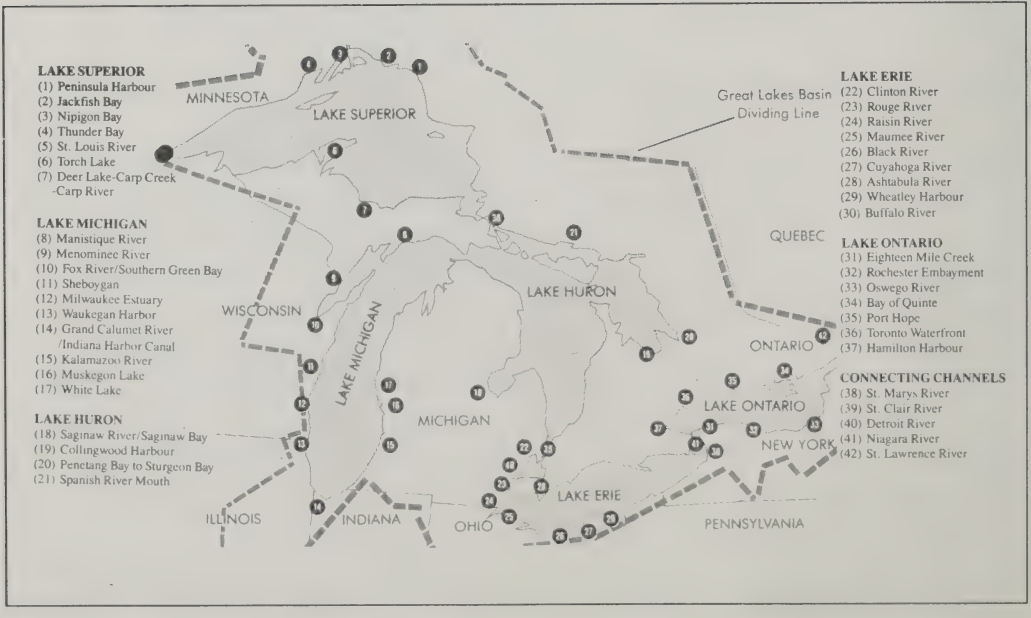
Commission (IJC) was set up under the Boundary Waters Treaty to deal with water quality in those bodies flowing on and across the Canada-United States border. Although most of its work is related to water quality, the IJC has undertaken a several major studies of water levels in the Great Lakes.

In 1972, Canada and the United States entered the first Great Lakes Water Quality Agreement and, in 1985, the IJC designated 42 Areas of Concern (so-called hot spots) in the Great Lakes — those places in which there were levels of pollutants serious enough to warrant concern and action. The Toronto waterfront is one such area. Among the others are Hamilton Harbour, Port Hope, the Bay of Quinte, and, in particular, the Niagara River — generally identified as the largest single source of pollution in Lake Ontario and the one most in need of remediation.

Problems identified in the Toronto area include:

- bottom sediments contaminated by bacteria, metals, PCBs, and other chemicals;
- bioaccumulation of metals and organics by organisms living in the sediments;
- fish of some species so severely contaminated they cannot be eaten safely by humans;
- an aquatic community under stress from sewage treatment plant outfalls, poor water circulation, changes in water temperature, habitat destruction, and chemical contamination; and

Figure 15. 42 Areas of Concern in the Great Lakes



- beaches that must be closed often during the summer.

The Canada-Ontario Agreement Respecting Great Lakes Water Quality, signed in 1985, was the mechanism for the federal government to act on the commitments it made in the Great Lakes Water Quality Agreement. Under the Canada-Ontario agreement, Environment Canada and the Ontario Ministry of the Environment are jointly co-ordinating the preparation of a Remedial Action Plan (RAP) for the Toronto waterfront, as well as for the other 17 Areas of Concern in Ontario. The approach taken by RAP is set out in Goal 7:

> Lakefilling should not be permitted unless it can be demonstrated not to impair beneficial uses of aquatic ecosystems. All possible means of improving the environment as a result of each project should be explored as part of the planning process in any development.

As a substantial landowner, the federal government also has a stake in the waterfront, through its various agencies and Crown corporations, including the Toronto Harbour Commissioners, the Oshawa Harbour Commission, Canada Post, and CN Rail. Federally owned lands are generally not subject to provincial or municipal regulations, at least with respect to federally regulated activities such as shipping and navigation.

The federal government has played a modest role in shoreline policy, planning, and standards enforcement along the shores of Lake Ontario. It has also been less active along the Lake Ontario shoreline than on Canada's three ocean coastlines. For example, although in British Columbia the federal Department of Fisheries and Oceans is a leading member of the Fraser River Estuary Management Plan, in Ontario it leaves implementation of most of its programs to the provincial Ministry of Natural Resources.

The Provincial Government

The provincial government has constitutional responsibility in such fields as property and civil rights, municipal institutions, and management and sale of its publicly owned lands.

The Ontario Ministry of Natural Resources is responsible for water quantity, erosion, and flood control, Crown land grants, wetland preservation, and fishery protection — the latter under the federal Fisheries Act through the Canada-Ontario Agreement. MNR also controls the sale or lease of Crown waterlots (land under lakes) that have not previously been sold to private owners. The Ministry has legislative responsibility for conservation authorities, and provides part of the financial support for them.

In 1986, MNR instituted a Shoreline Management Review Committee to convene public meetings and study ways of managing erosion and flood control along provincial shorelines, including the Great Lakes. The Review

Committee identified prevention of future development in hazardous areas as the highest shoreline management priority.

Subsequently, MNR prepared a draft statement on planning for shore lands of the Great Lakes-St. Lawrence River system, to be considered as a policy statement under the Planning Act, which is administered by the Ministry of Municipal Affairs.

The provincial Ministry of the Environment has general responsibility for protecting the quality of Ontario's water, air, and land. However, provincial jurisdiction with respect to the shoreline is not all-encompassing: the federal government has priority with respect to fish, navigable waters, and trans-boundary waters. The Ministry administers legislation to assess the environmental impact of various projects and control emissions of most pollutants. It has delegated its authority for monitoring lakefill quality to the Metropolitan Toronto and Region Conservation Authority (MTRCA). MOE has recently assumed responsibility for planning and approval of future waste disposal sites for Metro and the four surrounding regions.

The MOE also helps municipalities provide water and sewage treatment facilities. Provincially supported servicing initiatives, such as the York-Durham Servicing Agreement, resulted in tremendous development pressure, contrary to provincial planning initiatives. Clearly, new servicing initiatives along the shoreline will have the same result. Therefore, development should be carefully integrated with all shoreline planning.

The Ministry Municipal Affairs is responsible for scrutinizing land-use planning and project approval. Most planning decisions are delegated to regional and local municipal councils, subject to approval by the Minister and the provincially appointed Ontario Municipal Board.

The Minister of Municipal Affairs has the power to scrutinize, supersede or influence municipal planning decisions. The power to closely scrutinize development proposals is signalled by a declaration of interest, as in the cases of the East Bayfront/Port Industrial Area and the Oak Ridges Moraine.

Generally, a Minister of Municipal Affairs allows municipal decisions to stand but, in the past, ministers have influenced municipal planning decisions by approving policy statements on aggregate extraction, floodlands, and affordable housing, and by circulating draft guidelines on wetlands and floodlands.

The provincial government has the legislative authority to do its own land-use planning and development control, which it exercised to establish both the Niagara Escarpment Commission and the Parkway Belt.

Along the Greater Toronto Bioregion shoreline, the provincial government owns Darlington Provincial Park, Rouge Valley Park and a number of sewage treatment plants. It also owns several large redevelopment sites, including

those formerly occupied by Lakeshore and part of Whitby psychiatric hospitals, and controls other sites through provincial agencies such as Ontario Hydro and Ontario Place. Provincially owned sites are not subject to the usual municipal planning controls, unless the Province agrees to be bound by them.

Regional Governments

Metropolitan Toronto was created in 1953, and the regions of Halton, Peel, and Durham were established in the early 1970s to service areas of rapid growth. The Province gave the regions jurisdiction for regional land-use planning, and were expected to prepare comprehensive plans within five years of being established.

The Metropolitan Toronto Official Plan, approved in September 1981, identifies certain existing and proposed lands as "waterfront lands" and names MTRCA as its agent in developing the waterfront. The Plan sets out guidelines for waterfront development and recognizes both the fragile environmental character of the waterfront and the demand for boating facilities and water-oriented recreational facilities. A new Metro Official Plan is currently being prepared, and is expected to contain a more detailed waterfront section than that found in the 1981 Plan.

The Halton Region Official Plan, prepared in close consultation with local municipalities and the Halton Conservation Authority, was approved by the Minister of Municipal Affairs in 1980. The Plan defines a waterfront public use area that is to be supplemented with lakefill. The Halton Plan also requires an environmental impact analysis of waterfront development. Halton Region has also established an Environmental Advisory Committee to advise the regional council on environmental issues related to the waterfront and other areas of the region. The Plan is currently under review, and substantial efforts have been made to involve the public in that process. The Peel Region draft plan, which has not been approved by the Minister, assigns responsibility for recreational development and management of the shoreline to the Credit Valley Conservation Authority but leaves it to the Ministry of Natural Resources to provide natural areas for purposes of preservation, recreation, and education.

The existing Durham Region Official Plan, approved in 1978, leaves most waterfront issues to local municipalities. A current review of the Plan designates waterfront as a major open space system. According to the new proposals, development must not affect environmentally sensitive and wildlife habitat areas; and observation and education areas are to be provided. Unfortunately, due to development pressure, Durham Region is particularly susceptible to loss of existing shoreline habitat in the near future, even before the new plan is approved.

With the exception of Halton, regional governments have not given high priority to enhancing or conserving the natural environment of their water-

fronts; instead, they have left responsibility to local municipalities or conservation authorities. Recently, there has been greatly increased interest in regeneration of the waterfront, and a new generation of plans is in preparation. However, the danger remains that each of them will be developed and approved in isolation from the others.

Cities and Towns

There are 11 cities and towns on the Lake Ontario shoreline between Burlington and Newcastle; they range in size from the City of Toronto, with a population of approximately 600,000, to Newcastle, with approximately 38,000 people.

Historically, regulating land use is one of the most important powers the provincial government has delegated to municipalities. Most forms of development are decided by municipal councils, subject to comment by various local and provincial agencies and subject to appeal to the Ontario Municipal Board.

Boundaries for the 11 municipalities extend well out into Lake Ontario: because the Municipal Act defines it as land, municipalities have the power to pass official plans and zoning by-laws on land covered by water.

Municipalities may develop plans in conjunction with neighbouring municipalities. However, local municipalities have spent most of their energy reacting to specific development applications on existing land within their boundaries. They have paid little attention to the impact of their proposals on the shoreline or on neighbouring municipalities.

Recently, there has been a resurgence of interest in local waterfront planning. The cities of Toronto (City of Toronto, *Central Area Plan,* 1991) and Mississauga (Mississauga, *Vision 2020*) have been particularly active. Other municipalities, such as Oakville, have adopted aggressive policies to acquire a public shoreline strip whenever a waterfront site is developed or redeveloped. The City of Toronto has initiated an Office of Environmental Protection, which provides input into development decisions related to the shoreline or other environmentally sensitive locations.

Zoning by-laws turn planning concepts into legally enforceable restrictions on development; they can restrict or permit end uses. Only the City of Toronto has actively zoned offshore areas. However, present zoning by-laws do not limit the amount or configuration of land created by lakefill. It is not clear whether zoning by-laws are adequate for controlling shoreline development.

Harbour Commissions

Even before Confederation, the north shore of Lake Ontario was the site of considerable industrialization and urbanization. There was pressure to alter the shoreline to provide additional land for railways, industry, and shipping.

In 1911, at the request of the City and Board of Trade, the federal government passed special legislation creating the Board of Toronto Harbour Commissioners (THC), and giving it considerable authority and resources to operate a port and to plan, develop, and manage the City's waterfront assets in the public interest. In 1912, the Board produced a plan for massive development and lakefill on the central Toronto waterfront. Since that time, the THC has created some 1,000 hectares (2,500 acres) of waterfront land.

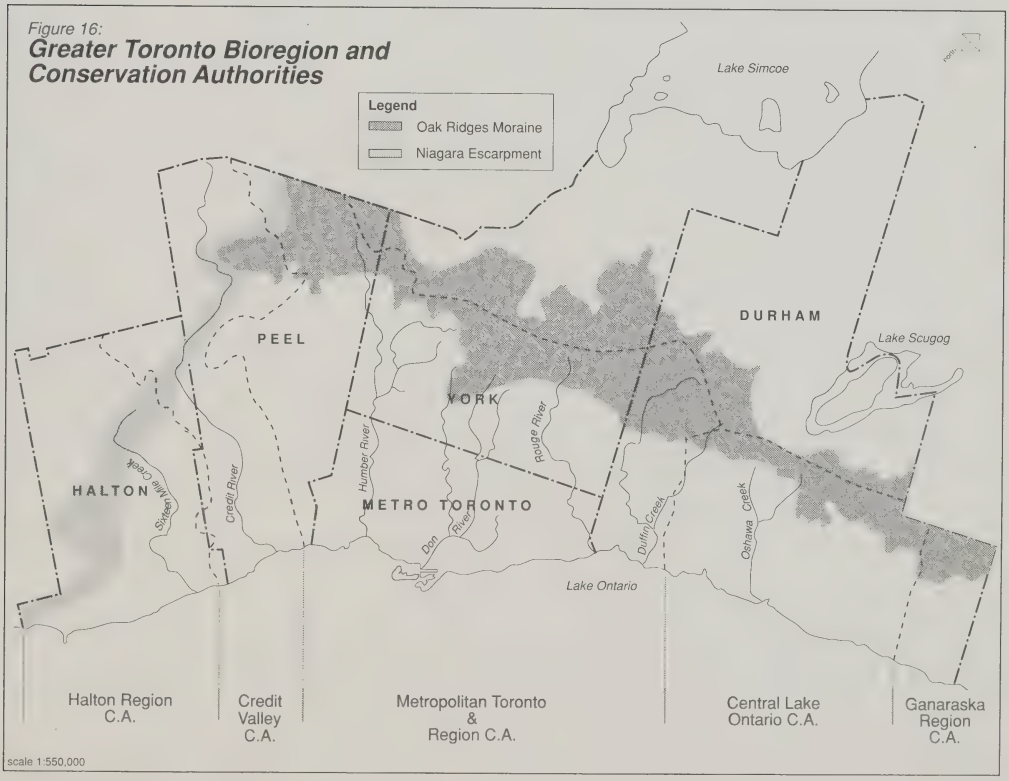
Although a federal agency, the THC has been exempted from other federal legislation, such as environmental assessment; nor is it subject to provincial environmental or municipal planning legislation. The Oshawa Harbour Commission, established under the Harbour Commissions Act, has a similar mandate with respect to the Oshawa Harbour.

Conservation Authorities

Five conservation authorities — Metropolitan Toronto and Region, Halton, Credit Valley, Central Lake Ontario, and Ganaraska — manage certain resources in the watersheds from Burlington to Newcastle.

Under the Conservation Authorities Act, authorities can be established on a watershed basis with power to control the flow of surface waters to prevent floods or pollution, alter the course of any river, and use lands for park or other

Figure 16:
Greater Toronto Bioregion and Conservation Authorities



recreational purposes. The responsibility of conservation authorities for waterfront planning is less clear.

The fact that authorities are constituted on a watershed basis helps them deal effectively with issues like water quantity. However, for the most part, the five watershed areas along the GTB shoreline are located in one large littoral cell, with boundaries at Burlington and Whitby. The littoral cell is a natural shoreline segment defined by the origin, circulation, and disposition of littoral sands on a stretch of shore. Consequently the envelope defined by the littoral cell is a natural unit for managing a shore. Management of the GTB littoral cell is fragmented. By contrast, the three authorities in the cell to the east of the GTB have developed a co-ordinated shoreline management plan.

Historically and financially, the degree to which the five conservation authorities are involved with waterfront issues has varied. Responsibility for funding, and the make-up of the individual authorities, are shared between area municipalities and the provincial government. A wealthier region, like Metro, can contribute more funds to its conservation authority than municipalities in less affluent areas such as those in the Ganaraska watershed. As development pressure increases and public funds are increasingly constrained, some authorities have entered into development arrangements. There is concern that some authorities are neglecting the tasks specifically given to them — protection and conservation — and becoming more oriented to intensive recreation and development.

In the early 1960s, Metro Council established several committees to prepare a comprehensive plan for 80 kilometres (50 miles) of Lake Ontario waterfront from Clarkson, on the western boundary of Peel, to Ajax. In 1967, these committees produced the Waterfront Plan for the Metropolitan Toronto Planning Area. It offers an ambitious range of proposals for waterfront parks and developments, including lakefill formations, marinas, launch ramps, artificial lakes, and inner waterways.

The provincial government gave MTRCA and the Credit Valley Conservation Authority responsibility for implementing the 1967 Waterfront Plan in their areas. Although it was subject to little public input, environmental assessment or formal approval process, the plan has had considerable impact on the lakefront. It either encouraged or reflected the pattern for waterfront development to the present: large projects built on fill extending out into the lake, dominated by privately operated marinas and boat clubs.

In 1986, conservation authorities were given responsibility for implementing and administering MNR's flooding and erosion policies. As mentioned earlier, a shoreline management plan was developed jointly by the Central Lake Ontario, Ganaraska, and Lower Trent conservation authorities.

While conservation authorities have clear legislative responsibility for flood and erosion control, their jurisdiction over other waterfront activities — preservation, recreation or development — is less clear. Although the provincial government recently undertook a review of the mandate of conservation authorities, no action has yet been taken to clarify their roles in shoreline protection.

The Work Group attempted to find out who is in charge of shoreline management and regeneration and discovered that the Lake Ontario shoreline in the GTB comes under the jurisdiction of 11 local municipalities, five conservation authorities, four regional governments, at least six federal and provincial ministries, several Crown corporations, several provincial agencies, boards, and commissions, and two harbour commissions.

As a result of the profusion of responsible agencies, governments, and boards, some projects — such as the construction of a dock projecting into the lake — receive detailed scrutiny from all three levels of government. Other issues, such as cumulative environmental effects as the result of the quality of lakefill, are not adequately addressed by any level of government. Obviously, the multi-jurisdictional approach results in a patchwork quilt of regulations rather than a comprehensive approach to setting and achieving goals for developing and protecting the shore.

With so many levels, departments, ministries, and special purpose bodies, it is difficult to find one that is clearly in charge.

Legislation, Regulations, and Guidelines: The Rules of the Game

Governments have a number of mechanisms available to facilitate and control shoreline management and regeneration. Legislation, once it has been passed, sets out general rules and is binding and legally enforceable. Regulations, which must be passed pursuant to regulatory powers specified in the legislation, set out more detailed rules approved by the federal or provincial cabinet. Municipal by-laws define rules for those areas in which the Province has given the municipal government authority. Official plans and zoning by-laws are legally enforceable, but are relatively easy to amend.

Guidelines, which may also be called policies or standards, do not depend on statutes for their effect. They are generally formulated by public servants and brought to the attention of the relevant minister or the entire Cabinet, but are not debated in the legislature and do not have the force of law in the courts.

In Ontario, there are no laws, regulations or guidelines that deal comprehensively with shoreline management and regeneration. There are, instead, many separate pieces of legislation and related regulations and guidelines covering environmental approvals, water pollution, land-use planning, and the disposition of waterlots. These require more than formal enactment to be effective:

there must be the political and bureaucratic leadership to monitor and enforce existing legislation and regulations.

Legislation does not usually affect government departments or agencies, unless it specifically "binds the Crown"; nor can a lower level of government interfere with a power properly exercised by a higher level. For example, the City of Toronto could not pass a zoning by-law that interferes with the power of the THC to regulate shipping.

Federal Environmental Approvals

Projects on federal lands, those initiated or funded by federal departments, and those for which there is federal decision-making authority must comply with the 1984 federal Environmental Assessment and Review Guidelines Order. The federal environmental assessment review process (EARP) requires that a department initiating a project carry out an initial evaluation of its potential impact on the environment. If it is likely to be substantial or if there is significant public concern about the project, a panel must be convened to conduct a full public review. Recent court decisions involving the Rafferty-Alameda Dam and the Oldman River Dam established that compliance with the order is compulsory. However, the Ministry of the Environment has just announced that the federal power to require a full environmental review will be waived in the Rafferty-Alameda project.

In June 1991, the federal government began clause-by-clause consideration of Bill C-13, a proposed Canadian Environmental Assessment Act. The draft bill requires public assessments of major projects, and a draft discussion paper sets out 10 categories of major projects requiring a comprehensive study, including any project that modifies more than 30 continuous kilometres (98 miles) of shoreline.

Bill C-13 also formalizes the public review process, provides for intervenor funding, and compels an assessment of cumulative effects. However, as written, the legislation appears not to bind the THC, one of the agencies most active in lakefill and other modifications of the Toronto area shoreline.

Under the Fisheries Act, the federal government has the power to control the deposition of deleterious substances affecting fish, and can prohibit any person from carrying on any work or undertaking that results in the harmful alteration, disruption or destruction of fish habitat. Fish habitat is broadly defined to include spawning grounds and areas used for nursery, rearing, food supply, and migration purposes on which fish depend directly or indirectly.

The Department of Fisheries and Oceans has developed a Fish Habitat Policy that includes the guiding principle of "no net loss" of fish habitat. Under it, the Department strives to balance any unavoidable habitat losses with

replacement on a project-by-project basis. The policy applies to all projects, of whatever size, in or near the water, that affect fish.

In Ontario, administration of the Fish Habitat Policy has recently been turned over to the Ministry of Natural Resources through the Canada-Ontario interim referral process. Proposals that could affect fish habitat, such as the St. Mary's Cement dock expansion, or the proposed Etobicoke motel strip development, are subject to review under the Fisheries Act.

The purpose of the federal Navigable Waters Protection Act is to protect shipping from interference. No work can be placed in, upon, over, under, through or across any navigable water unless the work and the site and plans have been approved by the federal Minister of Transport. Any dock, retaining wall, marina facility, excavation, dredging, dumping or disposal of material in navigable water is subject to the act.

The Toronto and Hamilton harbour commissions were established by special legislation, while that for Oshawa was established under the provisions of the general Harbour Commissions Act. In both types of legislation, harbour commissions have authority to regulate and control the use of land for port purposes, and to pass by-laws dealing with shoreline landfilling activities.

Provincial Environmental Approvals

In Ontario, provincial projects costing more than $1 million and municipal projects of more than $3.5 million are subject to the provincial Environmental Assessment Act. All waste disposal sites, whether public or private, are also subject to environmental assessment by the Environmental Assessment Board.

Under Ontario's Environmental Assessment Act, environment is broadly defined to include:

- air, land or water;
- plant and animal life, including people;
- the social, economic, and cultural conditions that influence the life of individuals or the community;
- any part or combination of the foregoing and the relationships between any two or more of them.

The last part of the definition is the closest any provincial legislation comes to requiring an assessment of cumulative environmental effects, but it doesn't take into account the effects resulting from many projects.

Under the Act, project proponents must present:

> a description of the undertaking, alternate methods of carrying out the undertaking, and alternatives to the undertaking, together with

a description of direct and indirect environmental effects of the undertaking.

After the legislation was passed in 1975, many public-sector undertakings, including a number of lakefill projects, were exempted from it. However, thanks to political pressure from environmental groups and the public, virtually all significant public-sector projects are now subject to either individual or class assessments under the Act. The Minister of the Environment may order a public hearing as part of the assessment process, and public interest groups are now eligible to receive intervenor funding.

MTRCA submitted plans for Colonel Samuel Smith Waterfront Area to the environmental assessment process in 1979. Provincial MOE staff recommended that the undertaking be rejected, because of its probable negative impact on the aquatic environment. However, in 1980, the Environmental Assessment Board held a public hearing and approved the project, because, it said:

> the proposed undertaking offered a unique opportunity to provide waterfront access, as well as water-oriented recreational activities without causing a significant impact on the adjacent aquatic and social environments. (Environmental Assessment Board, *Environmental Assessment Act Hearing*, *Colonel Samuel Smith Master Plan*, 1980, 22)

A class environmental assessment is less rigorous than an individual assessment and is applied to activities in which the environmental impact is expected to be minor, predictable, and relatively similar from case to case. The proponent in a class environmental assessment is obliged to develop a document setting out assessment procedures for various categories of activities within that class. Some types of projects are "bumped up" to an individual assessment.

Several types of activities likely to affect the shoreline are subject to class environmental assessments; they include shoreline and streambank stabilization, water-related excavation, dredging and fill activities, and municipal sewage and water projects.

Metro has submitted a proposal to expand the Main Sewage Treatment Plant and add lakefill to its southern end. The plan raises questions about alternatives to sludge incineration and lakefilling, including water conservation measures and other methods of disinfection. Initially, the project was to undergo class assessment, but Metro Council has now asked the Minister of the Environment for the more rigorous individual assessment.

Because the Environmental Assessment Act applies to private-sector undertakings only when they are for waste disposal sites or specifically designated by the Minister of the Environment, St. Mary's Cement's plan to substantially alter the shoreline in Durham Region is not automatically subject to assess-

ment, while a similar undertaking by a municipality or conservation authority would be.

The Minister of the Environment, the Honourable Ruth Grier, has said it is necessary to think in terms of how the EAA should be more regularly and broadly applied to the private sector, rather than simply whether it should be.

Ontario's existing environmental assessment legislation has been criticized as costly, complex, inconsistent, and often time-consuming. The time from submission to approval is now approximately two years. The Minister agrees that the environmental assessment process must be improved and hopes it can be done by the end of 1991.

There are other problems as well: as the Royal Commission publication, *Environment in Transition,* points out,

> An environmental assessment is normally carried out by a proponent of a particular development proposal... Because assessments are geared to individual projects, they tend not to take into account the cumulative effects of a number of projects. (Royal Commission on the Future of the Toronto Waterfront, *Environment in Transition,* 1990, 18)

In a working paper prepared for the Royal Commission entitled *Towards Ecosystem-Based Planning: A Perspective on Cumulative Environmental Effects*, Dr. Kate Davies outlined the desirability of having a comprehensive, environmentally based planning framework, with public input, before assessing individual projects.

While the provincial Environmental Protection Act, designed to protect the air, land, and water from harmful contaminants, considers many types of emissions and pollutants, its treatment of lakefill materials was of particular interest to the Work Group.

The waste section of Chapter 2 comments on the importance of Part V of the Environmental Protection Act, and how waste is classified, controlled, and deposited on the shoreline. Included in that chapter is a discussion and critique of the key management tool, the Improved Lakefill Quality Control Program (ILQCP), which is operated by the Metropolitan Toronto and Region Conservation Authority.

The regulation of lakefill sites in Ontario has been inadequate, from both an environmental and a land-use perspective. Recently, provincial staff have proposed four different guidelines designed to remedy past deficiencies:

1. The Guidelines for Lakefilling Activities in Ontario, proposed by the Ministry of the Environment in 1990, have been developed to ensure that lakefilling does not significantly impair water quality, aquatic habitat, and uses in adjacent areas. The Guidelines include criteria for design, sit-

ing, construction, and filling. They also propose amendments to the Environmental Protection Act to require lakefill proponents to submit a project plan and receive a Certificate of Approval for lakefilling structures before construction can begin.

2. MOE staff has also brought forward a Proposal for Developing Classification Policy for Materials Management to replace 19 different guidelines for handling and disposing of materials. Materials would be divided into two main divisions: waste, and exempted waste. Exempted waste would include innocuous material, suitable for unrestricted aquatic or terrestrial disposal, and clean material, suitable for restricted aquatic or unrestricted terrestrial disposal. Waste would include a new category known as restricted fill which would permit a great deal of construction material to be disposed of in a new category of waste disposal site.

   In a meeting with the Work Group, representatives of the construction industry expressed keen interest in a classification system that would include a category such as restricted fill, and the identification of suitable sites, such as abandoned quarries, where that type of material could be deposited.

3. MOE staff are also working on Provincial Sediment Quality Guidelines defining three levels of exotoxic effect: no effect, lowest effect, and severe effect. (See "Water and Sediment Quality" in Chapter 2.)

4. The Ministry of Natural Resources has recently developed a draft Great Lakes-St Lawrence River Flood and Erosion Policy statement; this document has positive elements but leaves significant gaps because of its orientation to protecting people and property. Protection of habitat and natural areas requires greater emphasis.

The Ontario Water Resources Act prohibits discharge into a lake, river or watercourse or on any shore or bank, or into or in any place of any material that may impair its quality. In 1986, the Ministry of the Environment initiated a Municipal/Industrial Strategy for Abatement (MISA) aimed at controlling municipal and industrial discharges into surface waters. Regulations are being developed to control not just the concentration of contaminants, but also the total quantity of pollutants that can be emitted into surface waters. In addition, a number of municipalities, including Metro Toronto, have passed by-laws to regulate industrial discharges into the sewer system.

The provincial Health Protection and Promotion Act empowers a medical officer of health to monitor and protect against threats to public health from any source, including water. Under this legislation, the MOH for any region (or local municipality in Metro) has the power to warn residents against swimming in polluted waters.

The provincial Lakes and Rivers Improvement Act was originally enacted to control developments that would affect log drives; however, the scope of the Act has been expanded to include preservation of the natural amenities of Ontario's lakes and rivers and their shores and banks.

Ontario's Public Lands Act makes it an offence to throw or deposit any substance on public lands without ministerial consent, a provision that has been used to prohibit filling on some shorelines. The legislation also empowers the Minister of Natural Resources to sell or lease waterlots.

There are a number of federal and provincial statutes that touch on various aspects of shoreline activity. However, with the possible exception of the Fisheries Act, rather than being based on a broader ecosystem approach, they are designed to prevent a specific narrow range of activities. Despite the many pieces of legislation applicable to managing the shoreline, significant gaps remain, such as protection of natural areas, and dealing with cumulative environmental effects. Perhaps most serious, there is no co-ordinating mechanism to ensure that protecting and regenerating the shoreline are identified as goals and addressed by the many governments and agencies that share responsibility.

Land-Use Regulation

The Planning Act sets out a framework under which municipalities may adopt plans and zoning by-laws, and allow land to be divided into additional lots for more intensive uses.

Official plans are comprehensive documents that contain objectives and policies established to provide guidance for development in a municipality, having regard to environmental and other matters. There are extensive procedural requirements for public notice and participation before a plan is adopted or amended. A municipal plan becomes an official plan after it has been approved by the Minister of Municipal Affairs.

The planning process gives municipalities an opportunity to gather information, establish goals, develop options, and implement programs with respect to their shorelines. However, few local municipalities along the GTB shoreline, with the exception of the City of Toronto, have planned vigorously along the shoreline.

By setting rules regarding uses, heights, and densities, zoning by-laws become tools enabling municipalities to regulate specific development projects. Municipalities tend to amend their zoning by-laws frequently, usually in response to specific development proposals.

The Planning Act allows municipalities to pass zoning by-laws to restrict use of land (including that under water), but does not allow them to regulate the creation or configuration of land that is newly created, or to prevent destruction of natural habitat. By contrast, the Act does contain provisions that

allow a municipality to prohibit construction on land that is subject to flooding, and to prohibit a pit or quarry. There is an anomaly: if a municipality can regulate the removal of land containing sand or gravel, should it not also be able to regulate creation of land?

Each local municipality bordering on the Lake Ontario shoreline has professional staff who prepare municipal plans and review development applications. While plans are prepared periodically and are supposed to be reviewed every five years, municipal planners spend most of their time responding to specific development proposals, which frequently run counter to the official plan. Development proposals are also reviewed by a variety of municipal, special purpose, and provincial bodies, each from its own specialized perspective; but there is no one to consider the broader view.

Municipal planning, particularly along the shoreline, tends to be overtaken by case-by-case decisions on development. Both interim reports by the Royal Commission point out a number of problems with the Planning Act as it affects the waterfront, particularly the difficulty experienced in integrating environmental concerns into the land-use planning process. Most recently, the Royal Commission published a background report, *Planning for Sustainability*, which addresses these issues in depth. Until the weaknesses in content or application of the Planning Act are rectified, or some new planning mechanism is established, governments will be preoccupied with plan exemptions and individual projects.

The less known Planning and Development Act, which is another means of regulating land use in Ontario, differs from the Planning Act in three ways: it enables the provincial government to undertake planning directly; it permits planning for an area larger than a single municipality or region; and it allows development through a case-by-case permit system rather than as of right in a predetermined zone. The Niagara Escarpment Plan and the Parkway Belt Plan were both established under this Act.

There has been criticism about the time it took to establish the plans and about their inflexibility on minor amendments. On the other hand, a degree of rigidity may be advantageous, and these acts were put in place because the standard planning mechanisms were too flexible, and entirely ineffective in protecting the natural character of the designated areas.

Until recently, Ontario had a statute known as the Beach Protection Act, which made it illegal to remove sand from the bed, bank, beach, shore or waters of any lake, river or stream in Ontario, except under the authority of a licence issued under the Act. This legislation was repealed as part of an omnibus amendment to regulate the aggregate industry. Several scientists and environmental lawyers have suggested that this step ignored the need to protect beaches from activities that interfere with the natural transport and deposit of sand.

Waterlots

A waterlot may be defined as a parcel of land in the bed of a lake or other waterway. The owner of a waterlot has the right to use it, subject to appropriate federal and provincial legislation, or to sell it.

A waterlot does not have to remain under water: the owner may fill it and leave it undeveloped or build on it. If it is left unfilled, the waterlot may provide buffers for private industrial, commercial or residential uses, corridors for servicing facilities such as water intake or sewer pipes, or facilities for harbours or marinas.

Even when Ontario was still a colony known as Upper Canada, various parties sought to purchase patents (grants of land) under water from the Crown. In the 1830s, Toronto City Council applied for the patent of the waterlots south of Front Street, as a response to public concern about use of and access to the waterfront.

In 1854, the City granted part of its newly acquired land to the Grand Trunk Railway. During the latter part of the last century, many industries and individuals purchased waterlots along the Toronto waterfront from the Humber to the Rouge River. In 1911, numerous waterlots were granted to the newly formed Board of Toronto Harbour Commissioners.

A similar pattern of sales from the provincial Crown to other public and private interests occurred west and east of Toronto, although less frequently. In recent years, an increase in population and in the value of waterfront land has caused a resurgence of interest in waterlots along the GTB shoreline; currently, the Etobicoke waterfront has been an area of particularly intense interest.

In some cases, owners of properties adjacent to publicly owned waterlots have illegally filled in Crown land and constructed facilities such as swimming pools, and then tried to purchase an interest in the sites they had improved. In other cases, home-owners attempting to protect their lots have inadvertently constructed protective structures on Crown land, then attempted to purchase them.

It is estimated that there are approximately 10 waterlots on the shoreline from Burlington to Oakville, 21 waterlots along the Mississauga waterfront, almost 200 waterlots in Metro, and 18 waterlots along the Durham shoreline Some are covered by leases, licences or easements rather than outright grants.

Provincial policy regarding the creation of additional waterlots has been inconsistent over the years: in 1963, the Province announced that all grants of Crown lands bordering the Great Lakes were ended pending further study; in 1978 a moratorium was placed on further transfers of waterlots with private uses. Both restrictions were cancelled in 1985, and further commitments were made to grant commercially valuable waterlots to private owners along the

GTB shoreline, particularly in the Etobicoke area. This lack of policy regarding disposal of Crown waterlots left a great deal to the discretion of the district manager of the Ministry of Natural Resources.

On 17 December 1990, the Minister of the Environment said the government would move to halt unnecessary privatization of the shoreline and Crown resources such as waterlots.

Whatever the historical rationale for selling waterlots to private interests, it is apparent that such sales are difficult to reconcile with the principles of an accessible, open, and connected waterfront. Waterfront land in public ownership should generally remain there; when the provincial or federal governments are considering divesting themselves of waterlot properties, they should consider transferring ownership to a local municipality or conservation authority. Only when there is a clear offsetting benefit to the public should further sales of waterlots even be considered.

Planning and Approvals

In theory, preparing official plans to guide land use under the Planning Act could anticipate and address many of the shoreline issues raised in this report. The planning process should:

- include collection of adequate baseline information;
- recognize resource preservation and environmental protection as well as development goals;
- ensure consistent and effective adherence to those identified goals; and
- be well enough co-ordinated to ensure that such inter-regional resources as the shoreline are recognized and comprehensively and consistently protected.

However, the current planning practice falls far short of ensuring permanent protection for environmentally important areas along the shoreline —or elsewhere. As pointed out by the Environmental Assessment Advisory Committee, particularly in its Report 38, which deals with the Ganaraska Watershed, basic environmental information, particularly that concerning resources and values potentially threatened by the cumulative effects of more land use, is often unavailable.

Moreover, environmental protection needs and appropriate limits to development are not adequately identified and incorporated into official plans. The practice of considering individual projects that do not comply with a plan is especially destructive to achieving sound environmental goals. In fact, the current process of approving individual projects — which are almost invariably for more intensive land uses — means they are evaluated on a case-by-case

basis. Although comments are sought from authorities in various agencies, including those with environmental responsibilities, they focus on technical matters and agency-specific concerns, rather than on broader environmental needs.

Rather than setting comprehensive policy goals, environmental regulation has emphasized the reduction or elimination of particular pollutants. Environmental protection legislation concentrates on abating the worst pollution stresses, such as those caused by heavy industry. Environmental assessment was originally developed as a technical and scientific process for describing the effects on the environment of a single project or activity.

Unlike land-use plans, assessments are prepared by proponents or developers of a single project who submit them to regulatory agencies. They rarely contain a comprehensive overview of other activities in the area and the cumulative environmental effects they cause.

Consider the approval process as actually applied to existing lakefills along the GTB shoreline.

The only approval obtained for Promenade Park in Mississagua was a licence issued by Transport Canada under the Navigable Waters Protection Act. Bluffer's Park in Scarborough was originally accepted by Transport Canada and MNR and amendments were approved by municipal councils. No formal approvals under planning or environmental legislation were sought or granted. Colonel Samuel Smith Waterfront Area, a MTRCA project, was subject to environmental assessment, but, as built, it does not conform to the undertaking described to the EAB. St. Mary's Cement, a private company, has made application to acquire additional waterlots and for permits under the Lakes and Rivers Improvement Act, the Navigable Waters Protection Act, and the Fisheries Act. The criteria for approval under most of these statutes are unclear, which makes it difficult to measure individual projects against publicly stated objectives.

The major gap in the provincial approvals process is the lack of a comprehensive integrated plan that would serve as a reference point for considering individual projects and help to measure the cumulative effects of other projects.

Although land-use planning and environmental assessment are important tools in protecting the environment, neither is ideally suited to protect, manage, and enhance the shoreline. An ecosystem planning process is needed to reconcile use of shoreline areas with the conditions necessary to promote and protect ecosystem health — now and in the future.

Other Jurisdictions

Increases in population, wealth, mobility, and leisure have increased conflicts over shoreline use and alteration elsewhere in Canada and in the United States. Here is a brief overview of some of those most relevant to the concerns of this Work Group.

Fraser River Estuary Management Plan

Approximately 60 agencies, including two harbour commissions and six Indian bands, are involved in managing the Fraser River Estuary, on the outskirts of Greater Vancouver.

In 1985, the Fraser River Estuary Management Program (FREMP) was created by federal-provincial agreement in order to create a balance between economic activities and environmental concerns. FREMP consists of a small secretariat that co-ordinates the various agencies; a management committee of six agencies; and approximately 26 members at large.

It has categorized every area of the estuary according to its value as natural habitat. Large areas — those best for fish, birds, and animals — have been classed "red": they may not be developed at all. Areas of limited value for fish or wildlife are designated "orange": they may be developed if offsetting habitat improvements are made by developers. The remaining areas, with little or no habitat value, are available for development.

FREMP has also established an Environmental Review Committee to check all development proposals against the area designations, recommend action to regulatory bodies, and co-ordinate all necessary paperwork. This process is faster, more efficient, and more effective in protecting valuable habitat than the previous method, in which the developer went from one agency to another, seeking approvals.

Lakefill Control in the Atlantic Provinces

Several of Canada's Atlantic provinces deal with the issue of lakefill; for example, the Nova Scotia Environmental Control Council usually prohibits infilling, particularly if it deems loss to the watercourse to be greater than any public gain.

All applications to infill or alter wetland in Prince Edward Island are referred to the Watercourse Alteration Review Committee, and are generally not permitted unless they are considered in the public interest.

In Newfoundland, infilling for the public sector is permitted, provided no other reasonable alternative is available and the land will remain public property.

The Great Lakes: An American Perspective

The Royal Commission contracted with the Lake Michigan Federation, a citizens' group interested in lake protection, to review legislation and regulations pertaining to lakefill in the Great Lakes.

According to the Federation's report, the use of lakefill in the U.S. is regulated by a variety of federal, state, and local laws, as well as by common-law principles, as interpreted by the judiciary. While the multi-jurisdictional approach is similar to that in Ontario, there are a number of initiatives and standards worth examining.

Perhaps most significant is the Coastal Zone Management Act (CZMA), a federal statute that encourages states to adopt coastal zone management plans designed to preserve, protect, restore or enhance coastal zone resources, and to foster the wise use of coastal lands and water resources.

The U.S. Secretary of Commerce makes grants to states that meet the legislation's minimum standards, which include:

- identifying boundaries of the coastal zone subject to the program;
- defining permissible land and water uses within the coastal zone;
- defining and making an inventory of areas of particular concern within the coastal zone;
- setting out the means by which the state proposes to control land and water uses in the coastal zone;
- describing the organization or organizations responsible for implementing the program;
- describing the process that will be used to plan for protecting, and ensuring access to, public beaches and other public coastal areas of special value;
- explaining how the state will deal with energy facilities that may be located in, or may significantly affect, the coastal zone; and
- describing the processes used to assess the effects of shoreline erosion, evaluate ways of controlling such erosion, and restoring eroded areas.

As well as encouraging adoption of comprehensive shoreline plans based on ecological principles, there are standards for approving individual shoreline projects. The Clean Water Act authorizes the Army Corps of Engineers to issue permits allowing the discharge of dredged or fill material into U.S. waters. The Corps must take three factors into account: state water quality standards (which vary); the environmental impact of the proposed fill; and the public interest review standard. The latter requires the Corps to balance the expected benefits

of a project against reasonably foreseeable problems, including any cumulative impact on the environment. Among the factors to be considered are consequences to the economy, conservation, aesthetics, wetlands, historic properties, fish and wildlife, water quality, water supply and conservation, navigation, and the general public welfare.

Environmental impact is measured according to guidelines that dredged and fill materials should not be discharged into the aquatic environment unless the proponent can demonstrate to the Corps of Engineers that the discharge will not have an unacceptably adverse impact on:

- human health and welfare;
- aquatic life; and
- wildlife that is dependent on the aquatic environment, or on the diversity, productivity, and stability of the aquatic habitat, either individually or in combination with another known or probable impact from other activities affecting that environment.

Several states bordering on the Great Lakes have established comprehensive policies on shoreline alteration and lakefill.

New York State has passed a Water Revitalization and Coastal Resources Act that conforms to the federal government's CZMA. The CZMA is designed to co-ordinate all federal, state, and local coastal zone activities, and to encourage local governments to adopt local Waterfront Revitalization Plans; these are detailed land-use plans that set out local waterfront objectives and policies.

Lakefill may be allowed when it is intended for water-dependent purposes that would not be out of character for the specific location and would not have unacceptable environmental consequences. However, state policy prohibits such projects as fill if they would destroy or significantly impair coastal fish and wildlife habitats.

Michigan also complies with the CZMA, regulating development through the Great Lakes Submerged Lands Act (GLSLA), the Goemaere-Anderson Wetland Protection Act, and the public trust doctrine, which states that unpatented submerged lands are to be held by the state in trust for the public at large. Under the GLSLA, Michigan cannot issue a permit for a proposed fill unless adverse effects are minimal or will be mitigated, or in cases where there are no reasonable and prudent alternatives.

The overall effect of these laws and doctrines is to prohibit all fill activity in Michigan's Great Lakes, except for those associated with shore protection or harbour development.

Illinois relies heavily on the public trust doctrine to regulate shoreline alteration and lakefilling. In applying the doctrine, Illinois allows lakefilling for

public but not for private benefit, as long as it does not significantly impair the public's right to navigate and fish. The courts are quite willing to review lake-fill decisions on behalf of interested citizens.

U.S. Pacific Coast

Several U.S. jurisdictions outside the Great Lakes area have adopted progressive measures to protect and enhance their shorelines. For example, under the Shoreline Management Act of 1971, the State of Washington requires local governments to prepare master programs containing environmental inventories and long-term plans; the plans cover the natural, rural, urban, and heritage environments.

The San Francisco Bay Conservation and Development Commission includes representatives from each of the 13 counties and cities located on the bay, as well as state appointees and citizen representatives. The objectives of the Commission are to protect the bay as a great natural resource for the benefit of present and future generations and to develop it and its shoreline to their highest potential, with a minimum of filling. A number of features of the San Francisco Bay Commission may be applicable to the GTB shoreline:

- many interests are represented on it, but none dominates the Commission;
- it controls planning, zoning, and fill in the waters of the bay, the lands beneath the bay, the tidal zone, and a 30-metre (33-yard) strip of land above the high tide mark; and
- the geographic area covered by the Commission is large enough to involve regional issues but small enough to engender public understanding and support, which the Commission encourages and nurtures.

Conclusions

Each of the Canadian and U.S. jurisdictions referred to above approaches shoreline regeneration in a slightly different way, but there are some important common threads amongst them:

- Authority to deal with shoreline issues is set out clearly, either in legislation or through the court's interpretation of the common law.
- The government of the state, province or bioregion (in the case of the Fraser River Estuary) has shown leadership in dealing with the problem.
- Shoreline planning is undertaken on a broad regional basis, rather than being narrowly municipal; moreover, the process involves local municipalities and agencies, rather than imposing after-the-fact decisions.

- In most cases, there are overall policies or plans as well as standards against which individual initiatives can be measured.
- Many of the jurisdictions have established co-ordinating forums or mechanisms to bring numerous agencies to the same table.
- Legislation focuses directly on the issue of shoreline regeneration, as well as on the related issues of land-use planning and water quality.
- Public input is encouraged in establishing and enforcing policies, plans, practices, and use of technologies in shoreline regeneration.

Summary

The Work Group has reviewed the regulatory framework, as it exists in mid-1991, for the Greater Toronto Bioregion shoreline. The laws, regulations, and guidelines governing the shoreline are complex and show significant gaps and a notable lack of co-ordination. There are a variety of federal, provincial, and municipal initiatives under way to improve the situation. However, there are four issues that require fundamental re-examination rather than minor tinkering:

- fragmented jurisdiction;
- lack of planning co-ordination;
- an inconsistent and ineffective approvals process; and
- inconsistent public consultation.

Numerous government agencies, ministries, and departments approve individual projects on the GTB shoreline, according to narrow technical mandates. Missing is a co-ordinated approach, and a clear commitment to shoreline regeneration, based on a comprehensive and coherent plan — one that would provide a standard to evaluate individual projects.

CHAPTER 4

OPTIONS AND RECOMMENDATIONS

In Chapter 2, the Work Group discussed a variety of factors that contribute to the degradation of the Greater Toronto Bioregion shoreline. Water contamination, habitat destruction, obstruction of littoral drift, erosion, and beach closures are all too common, and stand in the way of shoreline regeneration. Despite the plethora of laws and regulations outlined in Chapter 3, some damaging projects seem to go ahead, and further degradation — rather than regeneration — is the likely result.

Chapter 3 identified the need for a clear commitment to regeneration and a comprehensive plan for the GTB shoreline. Such a plan would address the root causes of damage to the shore environment, including fragmented jurisdiction, lack of planning co-ordination, an inadequate approvals process, and failure to consider cumulative effects.

This raises several questions, including:

- Who should lead in developing the plan?
- What might such a plan look like?
- How would the plan relate to existing plans?

Clearly, the governments of Canada and Ontario have the authority and responsibility to deal with these issues. Therefore, it is logical that they should lead and co-ordinate the initiatives needed to deal with these complex matters, which have an impact on the GTB and beyond. However, municipal and regional governments and agencies also have important roles to play because they are closer to local situations, problems, and opportunities. On the other hand, no one municipality is in a position to take the lead because of limited authority, and the natural orientation to local concerns.

Recommendation

The governments of Canada and Ontario should adopt as a goal the regeneration of the shoreline of the Greater Toronto Bioregion, based on an ecosystem approach and emphasizing:

- **protection of remaining natural areas;**
- **rehabilitation of degraded areas; and**
- **consideration of cumulative effects in future shoreline development proposals.**

Recommendation

In order to achieve this goal, the governments of Canada and Ontario, in consultation with municipalities, regions, relevant agencies, and the public, should develop an integrated plan for the GTB shoreline.

There are already many municipal, regional, and conservation authority plans in the GTB. They have not led to regeneration of the shoreline because they are fragmented and focused solely on local concerns. What is needed now is a framework, a "GTB Shoreline Plan" to guide and co-ordinate the local plans, to provide integrated planning and approval practices and a coherent set of goals and objectives. As a first step, existing laws and regulations, such as the Fisheries Act, should be applied vigorously, and planning should be co-ordinated across the GTB. Furthermore, there is a need for a broader perspective, and a vision of the healthier, cleaner, greener, more diverse, and more accessible waterfront that is possible.

Boundaries of the Shoreline Plan

In determining the boundaries for the proposed shoreline plan, an ecosystem approach would suggest that the littoral cell, which extends from Whitby to Burlington, might define logical limits. Such a definition would enclose the natural movement of littoral sand and have a natural system rationale. However, the major consideration is the development pressures in this segment of the shore which are threatening the natural areas that remain. In fact, there are enormous potential benefits in providing a regenerated shoreline to the millions of inhabitants of the densely packed Metropolitan area.

The width of the special planning area could be roughly defined as the littoral zone of the lake, including the estuaries of rivers and streams. More study and consultation will be required to determine the appropriate amount of land included. It is likely that either an arbitrary margin, of perhaps 1,000 metres (1,100 yards), or several narrow bands, parallel to the shore, would define the landside zone for the purposes of the plan.

Recommendation

The governments of Canada and Ontario should determine the plan's geographic boundaries, recognizing the area's links with watersheds.

The plan's boundaries should be based on a rational ecosystem approach, and the senior governments should include all municipalities in the plan area, without exception, to ensure that the plan is effective.

Characteristics of the Shoreline Plan

Given the purpose of the framework — to co-ordinate and guide local plans and activities in order to regenerate the shoreline of the Greater Toronto Bioregion — the Work Group believes the Shoreline Plan should include certain important elements:

- principles, goals, and objectives (environmental, social, economic);

- clear identification of zones for protecting the natural environment (e.g., maps marked in red for most restricted areas, orange where special measures or care is needed, green for areas with the greatest flexibility);
- clearly defined approval and control processes that include:
    - "one wicket" applications for projects;
    - defined standards and codes;
    - limits on periods for comments;
    - public input; and
    - enforcement mechanisms.

The agency that would co-ordinate the development of the plan should also be responsible for implementing, interpreting, and communicating it. In order to carry out its mandate, this agency — which could be new or an existing body with new powers — should have:

- adequate human and financial resources;
- access to studies and data;
- sufficient means of persuasion and, if necessary, enforcement to ensure compliance;
- pre-emptive power, to stop work if necessary, before natural resources are destroyed; and
- no role as a developer or operator of facilities.

The planning process will be a very important element of the plan. The responsible agency should take a consultative approach to developing plans, goals, and objectives. Flexibility will be needed to accommodate the different communities involved and the varied opportunities. There should be a periodic plan review, perhaps every five years, to evaluate its effectiveness, and ensured continued relevance to the needs of the communities it serves.

The plan could be developed and implemented in several different ways, some of which are discussed, along with their advantages and disadvantages, in Chapter 5. The final plan would be a clear guide for developers as to rules and expectations, and a standard for administrators to measure proposals. Ultimately the land-use elements of the plan should be reflected in municipal, regional, and authority plans; shoreline restoration or protection projects should be built into the budgets of appropriate ministries and agencies.

Chapter 2 raised many issues related to shoreline regeneration, all of which will influence the proposed plan in some way. The following is a discussion of the substance of the issues, in broad categories, parallelling those in Chapter 2:

shoreline modification, waste disposal, water and sediment quality, habitat, and quality of life.

Shoreline Modification

Shoreline modification — including lakefilling, erosion control, dredging to maintain navigable waters, marsh filling, and construction of jetties, piers, and groynes — has been taking place on the GTB waterfront for more than a century. Concerns about lakefilling have raised a number of questions including:

- Can lakefill be carried out without introducing contaminated material to the lake?
- Can lakefill be designed and constructed to have a neutral or positive impact on the ecosystem?
- Should lakefilling be permitted, and, if so, where, under what terms and conditions?

The ability to carry out lakefilling without contamination depends on whether materials can be contained, and whether fill materials can be restricted to those that are harmless to the ecosystem. (The latter is addressed in the section of this chapter devoted to waste.)

As discussed earlier, the Work Group has concluded that a great deal of lakefilling expertise exists, both locally and internationally. Structures could be built to withstand a wide variety of storm conditions, providing lake levels remained within a comparatively narrow range, and the know-how exists to create structures which will greatly reduce the amount of fill released to the water column.

The lack of any design criteria, coastal engineering construction code, engineering standards, or effective enforcement mechanism to ensure that structures are built and maintained properly are reasons for serious concern. For example, the amount of turbidity and suspended solids released from lakefilling can be dramatically reduced by depositing soft fill in enclosed cells, behind a hard protective barrier.

Furthermore, the lack of standards permits dumping loose fill into the waves under storm conditions. This practice leads to considerable fill loss, silting, and turbidity. On the Leslie Street Spit, debris and timbers have been dumped at the fill face and released into the harbour, where the wood becomes a hazard for small craft.

Recommendation

Guidelines and construction codes for lakefilling or shoreline modification should be developed, and an effective monitoring and enforcement mechanism should be established.

Lakefilling Policy Options

Lakefilling — the practice of using deposits of fill material to create land from wetlands and the littoral zone — has various benefits as well as drawbacks that have been described earlier. Some individuals and groups have advocated an absolute ban, while others are promoting greatly expanded activity.

It is clear that the Province should take the lead in lakefilling policy because it has the broad responsibility for planning in the GTB, as well as the main instruments of authority including the Environmental Protection Act and, through the Canada-Ontario Agreement, administration of the Fisheries Act. From a policy point of view, the Province has three options:

- Leave lakefilling to local and municipal control.
- Ban all lakefilling except dredging for navigational purposes.
- Restrict it according to set criteria and conditions.

The following is a brief assessment of these three alternative approaches.

Local Option

Permitting local governments to control lakefilling presents several serious problems. The approach would be highly inconsistent, would be decided without much regard for neighbouring municipalities, and would evolve without regard for provincial objectives such as habitat protection, access, or the best use of unusual resources like marshes or estuaries. These problems could be partially offset if the Province imposed standards on local and regional plans.

However, there is no assurance that the federal government would give up its legal rights and responsibilities (such as those under the Fisheries Act) and agree to this approach. Similarly, it is doubtful that the Province could ignore its responsibilities under various provincial statutes. Finally, municipal control would make provincial standards, consideration of cumulative effects, and an ecosystem approach very difficult.

Absolute Ban on Lakefilling

Before discussing the criteria and conditions for restricted lakefilling, it is useful to consider the pros and cons of an absolute ban, a measure that has been advocated by those who are concerned for a variety of reasons, including: the introduction of additional toxic material to the water, objections to public dollars being used for private benefit, concern about the long-term public good of such measures, and doubts about the ability of those responsible to control the effects and deliver the promised benefits of lakefilling.

It should be noted that even a total ban would have to provide for maintenance of existing structures, which require regular replacement of materials dislodged or eroded by wave action.

If a ban were imposed, material now used in fill would have to be deposited elsewhere and would lead to increased direct costs: for example, using 1991 rates, the volume that went to lakefills in 1989 would cost an additional $18 million to transport and $225 million in tipping fees if it were deposited in licensed sanitary landfills.

Alternatively, additional disposal sites and uses could be found, but would have environmental and social consequences, including additional truck traffic and energy consumption as a result of the greater distances from sources, and increased costs of constructing offices, factories, and housing. On the other hand higher disposal costs and more difficult disposal would likely result in changes to building design to reduce excavation, and more waste would be used for landscaping; recycling of concrete, bricks, and asphalt would increase.

A total ban on lakefilling, including that completed with genuinely harmless fill, would result in the loss of some shoreline developments, residential as well as commercial and related economic activity and certain public amenities; pathways, parks, and other forms of public access would be too expensive or would not be possible on existing land.

Restricted Lakefilling

This option would allow lakefilling under some circumstances, in certain places, using a restricted range of materials, in those cases where a clear public benefit would result. For discussion, the following are proposed as criteria for the kind of lakefilling that could be approved; it would:

- have significant net benefit for the public;
- conform to an integrated shoreline plan (such as the GTB Shoreline Plan proposed in this report);
- pose no unacceptable risk;
- maintain or enhance the health of the environment and the general public; the quality of life; and the regional or national economy; and
- have adequate resources to ensure delivery of projected benefits.

The following is a brief discussion of the criteria proposed under a policy of restricted lakefilling.

Significant Public Benefit

Lakefilling carries risks as well as opportunities. When there is any miscalculation in carrying out a fill, the consequences are borne by the public, who own

most of the land beneath the lake as well as much of the shore. Therefore, it is reasonable to expect that the preponderance of benefits from shoreline modifications should accrue to the public — and this is doubly true when taxpayers foot the bill for most of the cost of modifications. For example, if land is to be added by lakefill, it is reasonable to insist that all or most of the addition will be for public uses. In this way access, habitat, sewage treatment or some other public benefit is provided.

Conforming to an Integrated Plan

Under the proposed GTB Shoreline Plan, any contemplated project involving lakefill would be measured against the goals of the plan. Second, each location would be compared with the plan restrictions. Third, the nature of the proposal would be compared with any criteria (such as coastal engineering standards) adopted as part of the plan. Fourth, any incremental stresses on the shoreline system likely to be introduced by the project would be considered in comparison with a "stress budget" maintained as part of the cumulative effects assessment in the total plan. The object would be to ensure that any project did not exceed incremental damage limits to the carrying capacity of the shore.

Recommendation

All new projects should be subject to the proposed integrated shoreline plan for the Greater Toronto Bioregion. It would assess the carrying capacity of the shore for additional lakefill projects and, should these be acceptable, would designate the most beneficial locations; exceptions would be by plan amendment.

Acceptable Risk

Many shoreline projects have had unforecast consequences. Stone hooking, the 19th-century practice of removing nearshore stones for use in building and ballast, resulted in loss of shoreline protection; moreover, it accelerated erosion and loss of valuable fish habitat. Protection of a stormwater outfall led to accelerated erosion of the Scarborough Bluffs, loss of property, and threats to the stability of dwellings. Lakefill at Humber Bay and Bluffer's Park trapped polluted waters in embayments. Given these unfortunate consequences, the public has good reason to be sceptical of proposals for shoreline modification, and to question the risks involved.

Therefore, it is necessary to consider the risk in any project, based on a proper assessment of a variety of factors, including:

- coastal dynamics, and the range of water levels;
- the impact of severe storms;
- the impact on aquatic and terrestrial habitat;

- the quality of the materials employed, including fill;
- effectiveness of the control and monitoring system to assure that both fill and construction standards are met consistently.

This risk assessment should be a standard part of any environmental assessment of a project and criteria for such an assessment should be a component of the Shoreline Plan.

Recommendation

Siting and design of any new facilities should take into consideration coastal dynamics, habitat enhancement, bypassing of sand if appropriate, embayments, the potential for concentration of contaminated sediments, and the proper dispersion of effluent from rivers and outfalls. Such projects should be subject to environmental assessment, including assessment of cumulative effects.

Maintaining/Improving Health and Environment

These criteria are meant to underscore the principle that no project should significantly degrade public health, the natural environment, the economy or the quality of life in the region. This would mean, for example, that a condominium development that would provide housing and economic benefits but lead to loss of fish habitat should not be permitted, or must include satisfactory offsetting habitat benefits.

Adequate Assurance of Projected Benefits

The public has reason to be wary, and to insist on adequate assurances that proponents have the ability and resources to deliver the promised benefits of a project; it also wants adequate mechanisms to ensure they do. For example, the 1980 presentation concerning Colonel Samuel Smith Waterfront Area promised many attractive public amenities that, nearing completion, have not been built and for which there is no budget to build. Only a private yacht basin with parking and winter boat storage, and a narrow public promenade, will be in place after the expenditure of $7 million of public money.

Recommendation

An effective mechanism should be put in place to monitor and control major projects; sanctions should be applied when the completed project does not correspond to what was promised.

Recommendation

Private facilities using lakefill structures should pay an appropriate share of capital and maintenance costs to ensure that demand is not artifi-

cially stimulated by subsidy and taxpayers are not offended by the use of their money for private benefit.

Having considered the options for lakefilling, and conditions under which future projects would be compatible with shoreline regeneration, we think it is necessary to address a second important element of shoreline modification: erosion control, the various measures designed to stop shoreline erosion. The following is a discussion of policy options available to the provincial government.

Shoreline Erosion Control Policy Options

Shoreline armouring and erosion control are widespread and ongoing; the current approach is a mixture of private efforts and public projects undertaken as budgets and political pressure permit. Some work is part of each regional conservation authority's responsibilities. In general, there appears to be a lack of understanding of the cumulative impact on the environment of armouring the shoreline, of different construction styles and their effectiveness. There is the appearance of doing something about erosion, but long-term efficacy is uncertain.

Many shoreline property owners expect public assistance in protecting their shorelines because they regard rapid erosion and storm action as natural disasters. Others see erosion of their property as accelerated by upshore activities conducted or permitted by government — such as groynes, piers, lakefill marinas, and bluff armouring.

Houses in danger as shore erodes away

There are several policy options for erosion control:

- Continue the status quo.
- Impose an absolute ban on future erosion control measures on public shoreline or waterlots, whether or not hazard lands are purchased with public funds.
- Impose a moratorium on new projects, with exemptions for emergency or hazardous situations, until the integrated Shoreline Plan is completed. Thereafter, only projects that conform with the plan would be approved.

Status Quo

The status quo option has serious weaknesses because it fails to consider the cumulative effect of many separate unco-ordinated erosion control projects. Habitat is changed or degraded without compensation, and downshore effects such as erosion are not always predicted or taken into account. Most serious is the tendency of various levels of government to make themselves vulnerable to demands for ad hoc expenditures of public money with private benefits and dubious long-term effectiveness.

A similar problem has been addressed by conservation authorities in their flood plain management strategies. Public monies expended for protection of private land have been controlled by developing a defensible hazard land policy, making it known to the public, and integrating it into the local planning and approval process.

Shoreline protection near South Marine Drive

Absolute Ban

Before considering a moratorium, it is useful to look at the consequences of an absolute ban on shoreline erosion control. It would leave no room for judging individual situations, although it is likely that circumstances will occur where erosion control measures can protect valuable public or private property at modest cost with no significant damage to the environment. While a ban might stop ad hoc measures, there is no evidence that it is necessary. Moreover, if it were adopted, an absolute ban would probably require an expensive program of hazard land acquisition and expropriation.

A Moratorium

A moratorium on new erosion control measures, pending an integrated shoreline plan and classification of sections of the shore, offers attractive possibilities and flexibility. However, planning and management should embrace more than hazard conditions. They should also include habitat protection and restoration, beaches, recreation opportunities, economic development, public access, and the dynamics of coastal processes.

The result of a review should be a classification system for each section of shore, including a rationale for defining sections where erosion control should be prohibited or limited. However certain degrees of erosion control could be permitted, actively supported and encouraged in appropriate places. A policy for hazard land acquisition and disposition of the land created by erosion control and lakefilling would be an element in the GTB Shoreline Plan, as would public benefit goals such as access, habitat enhancement, and protection of scenic views.

Conclusions Regarding Erosion Control

Equipped with an ecosystem-based policy and a shoreline plan, governments would be much better able to manage and control expenditures, reduce emergency demands, improve the effectiveness of monies spent, and achieve a healthier shoreline for both public and private use.

Waste Disposal

Lakefilling was traditionally looked on as an inexpensive and convenient means of disposing of wastes. In recent years, concern about pollution in the lake has led to restrictions on what is acceptable for open water disposal. In Metro Toronto, the conservation authority operates a fill quality control program under a letter of authority from MOE.

In this section, the Work Group addresses two major issues:

- What can be done to ensure that materials used for lakefill are harmless?

- What should be done with any materials diverted from lakefill?

Harmless Materials for Lakefill

Ensuring that only harmless materials are placed in the lake requires first a sound scientifically based classification system, and second, effective quality control. The subject of classification is addressed later in this chapter under Water and Sediment Quality.

Once material has been classified as appropriate for lakefill disposal, it is important to design an effective management system that includes control, monitoring, and enforcement arrangements.

The primary pollution issues are the actions necessary to make the lakefill quality control program 100-per-cent efficient and to ensure an adequate program outside Metro Toronto. At present, the program is administered by MTRCA, which has shown commendable initiative in getting it under way, and has systematically improved its operation. MTRCA has several handicaps, however: it lacks legislative powers of enforcement, operates only in Metro, and has a conflict of interest as both proponent and regulator of lakefill. Further, it is being asked to regulate an independent federal agency, the Board of Toronto Harbour Commissioners. The Ministry of the Environment is in a better position to fulfil this role, and should be given the necessary resources to do so.

Recommendation

Administration of the Improved Lakefill Quality Control Program should be transferred from MTRCA to MOE, which should be granted the resources necessary to carry out the program. A Certificate of Approval should be required for all major lakefills, under the Environmental Protection Act.

Recommendation

A system requiring manifests for transportation of excavated soil should be developed to ensure that soils go only to the approved disposal site.

Dealing with Materials Diverted from Lakefill

Some opponents of lakefill have advocated an absolute ban. Others have supported the imposition of more stringent guidelines for sediment. Both proposals would result in a very large volume of material diverted from lakefill. Application of MOE's draft guidelines for sediment quality would mean half the materials now being taken to lakefill would no longer qualify; in fact, the average annual volume diverted would be: under an absolute ban, 711,000 cubic metres (930,000 cubic yards); under new guidelines, 355,000 cubic metres (465,000 cubic yards).

Dealing with this diversion should take the classic "3Rs" approach: reduce, re-use, recycle (and arrange appropriate disposal for the residual). The following is a brief comment on the opportunities for each.

Reduce

Deep foundations in the city core are the source of a large quantity of fill for disposal; excavating is required because of the desire for extensive underground uses including parking downtown. Options for reducing this fundamental cause of fill include:

- reducing the requirement for underground parking (which will increase the need for public transit);
- increasing above-ground parking (with certain aesthetic, safety and economic consequences); and
- lowering densities in the city core and distributing office development to suburban areas.

These options would require extensive study because of their planning, environmental, and economic implications.

Many construction practices require removal of large quantities of material for water and sewer pipe repair and installation; therefore, new construction methods, such as trenchless technology (which allows installation of underground services with less excavation of material), which have been used in Japan and Europe, are being adapted for Canadian needs. However, few of these measures will be implemented as long as lakefill is available as an inexpensive disposal option.

Re-Use and Recycle

Large quantities of construction material will still remain to be re-used, recycled or disposed. Contaminated materials must be separated before the remaining matter can be re-used or recycled. The major limitations on that process are technology, cost, and lack of precision in regulatory standards classifying wastes. The objective, however, is to maximize the efficiency of separating contaminated soils that must be disposed of in approved solid or hazardous waste sites. Doing this both reduces cost to the generator (depending on incremental cost of the separation process) and achieves the social objective of reducing need for approved landfill or other disposal sites.

Any steps taken to improve technologies in Ontario for constructing or testing and separating contaminated soils are in keeping with a green industries strategy and are likely to provide trade opportunities that are a benefit to the Ontario economy.

In considering recycling, there is a small market for used bricks. Limiting factors are the cost of transporting material and purchasers' concern that they may not be completely clean. There are a large number of potential uses for clean, excavated materials, including noise berms, park landscaping, and golf courses. None of these alternatives represents a large annual quantity, or would begin to deal with the sheer volume of material normally sent to lakefill.

Recycling construction wastes is a relatively new element in the building industry: at present, primary opportunities are in crushing concrete for use in roadbeds and road fill. This approach has been carried out successfully at demolition sites near the Railway Lands. It must be remembered however, that concrete wastes are a small portion of the total volume, and are important in replacing the hard veneer on existing lakefills.

Chapter 2 dealt with the need to look on construction wastes as a resource. The potential exists to re-use excavation material to alter and improve the grade level of substantial areas of the downtown industrial area of Toronto currently subject to redevelopment. Ataratiri, the Industrial East Bayfront, the Railway Lands, and parts of the Garrison Common in and around Exhibition Park have the potential to employ millions of cubic metres of construction wastes, to raise low areas, create noise barriers, and carry out other useful projects. One of the advantages of such initiatives is the proximity of the receiving locations to the excavation sites. More work would be necessary to evaluate the suitability of the material and its value in redevelopment.

Recommendation

Studies should be undertaken to evaluate the feasibility of employing material excavated in the downtown core to alter the elevations of the nearby areas currently under consideration for redevelopment.

Alternate Disposal

Contaminated materials must continue to be sent to approved solid or hazardous waste disposal sites. Some are sent there now, not because of regulatory requirements but as a matter of convenience, and at added cost to the generator. While some material is required for daily cover, it is likely that large volumes will be actively discouraged at landfills because of the scarcity of capacity.

MOE is studying disposal of lakefill materials. In January 1990, it created the Materials Policy Committee to consider the fact that Regulation 309 of the Environmental Protection Act has only two categories of material: inert fill and waste.

The current definition of inert fill is so restrictive that virtually all fill is legally considered a waste and must be disposed of in rapidly disappearing landfill sites. The committee is exploring the possibility of creating a new classification of waste known as restricted fill, which could not be disposed of in

water but could be placed in a disposal site operating under a new category limited by certificate to accepting only that kind of waste. Such disposal might take place in pits and quarries within an economic hauling distance from Metro Toronto, providing it could be done in an environmentally sound manner. (A list of pits and quarries by township is included in Chapter 2.)

Recommendation

The Work Group recommends that Regulation 309 of the Environmental Protection Act be amended to create a new "restricted fill" waste category for excavated soil unsuitable for open water disposal, but not requiring the control of sanitary landfill.

Recommendation

The Group further recommends that a new system be developed by MOE to govern excavation of potentially contaminated soils. All excavation projects beyond 100 tonnes (110 tons) would have to be approved by the MOE. As part of the approval process, a decision would have to be made on managing soil, with priority given to re-use and recycling for clean soils. Soils too contaminated for open water disposal would be sent to land disposal sites, based on the new restricted fill classification set out above.

Recommendation

A new restricted fill approval system should be developed for land disposal sites designed to accept slightly contaminated soils.

Dredging

The Work Group reviewed dredging in the GTB and found that removal of dredge spoils to dry land would substantially increase costs and, unless the soils were cleaned, would offer no particular advantage over the current arrangement of confined disposal cells. Remediation would be extremely expensive at this time, and it would appear that contaminated urban and industrial soils should receive higher priority than dredged spoils.

The Group was not certain, however, of the adequacy of the approval and control mechanism for dredging.

Recommendation

The MOE should review dredging approval and compliance programs to ensure that dredge spoils do not degrade the water quality of the GTB shoreline.

Water and Sediment Quality

Water and sediment quality are related to shoreline regeneration in several important ways. Concern about the degraded quality of water and sediment in the GTB sets the context for considering shoreline projects, and stimulates the demand for improvement. After all, the Great Lakes are the source of water that millions use for drinking and bathing.

One of the most important conclusions arising from the discussion of water and sediment quality is that the shoreline receives large volumes of contaminants from sources upstream from the GTB shore, including tributaries, sewage treatments plants, sewer outfalls, and the Niagara River. Overall water and sediment quality cannot be improved without significant reduction in the contaminants from those upstream sources. This means that the Municipal/Industrial Strategy for Abatement (MISA), the Remedial Action Plan (RAP), sewage treatment plant improvement, combined sewer separation, and other programs to reduce contaminant discharges must be made effective if the state of the shoreline is to improve.

The contribution to pollution from shoreline modification arises partly from lakefilling with contaminated sediments; in fact, a surprising proportion of excavated materials are contaminated. Lakefill practices and subsequent wave action result in the dispersal of substantial amounts of fill material. While lakefill quality control programs in the Toronto area have tangibly reduced the amount of contamination, some fill which exceeds the guidelines slips through the system.

The Work Group regards lakefilling as a discretionary addition of material to the lake: there is always a risk that it will be dispersed in the water and there is no justification for introducing materials that further degrade water quality.

A second contribution from shoreline modification arises from the creation of embayments that trap contaminated sediments and obstruct the shoreline's natural ability to rinse itself. There was a division within the Work Group, with some members suggesting that contaminated water and sediments are the real problem, and once fixed, the embayments would be an asset. Further, they felt that immobilizing the contamination was preferable to having it circulate. Others believe the design of shoreline modifications should be changed to minimize the problem of embayments, at least until the sources are corrected.

Sediment Standards

MOE's sediment guidelines are the basis for the maximum level of any contaminant in material considered safe for disposal. The current official guidelines for sediments in fill for open water disposal were developed by MOE in 1976 and measure a very limited number of potential contaminants. In 1990, MOE developed *The Provincial Sediment Quality Guidelines: Draft* based on a

much wider range of contaminants, and set limits at levels at which the reaction of bottom-dwelling creatures was "no effect". The Work Group felt that these more stringent standards were in keeping with their conviction that nothing that would be harmful should be put into the lake.

Recommendation

Theguidelines from MOE's *The Provincial Sediment Quality Guidelines: Draft* of October 1990 should be adopted, and all material accepted for lakefill should comply with those standards and the "no effect" levels for contaminants.

Lakefill Quality

In May 1990, the MOE drafted new guidelines for lakefilling. They are too narrow in scope and are already outdated in that they did not incorporate the provincial sediment guidelines of October 1990.

At a minimum, new lakefilling guidelines should consider the impact of lakefill projects on aquatic habitat, having regard for the Department of Fisheries and Oceans policy of "no net loss of fish habitat".

Fish Consumption Guidelines

The MOE issues guidelines for the consumption of fish caught in Lake Ontario. Recent studies have suggested that consumption of more than the average amount of Great Lakes fish has health consequences.

Recommendation

MOE should review its criteria and guidelines to determine whether they adequately protect all consumers of Great Lakes fish.

Habitat, Aquatic and Terrestrial

Habitat destruction has been a serious consequence of changes and development along the GTB shoreline; species variety has decreased, and significant changes have taken place in the remaining biota. The shoreline is particularly important as habitat because its shallow water, protected areas, beaches, and estuarine marshes provide critical breeding and feeding zones and link species that reside in a much larger area. In addition, the shoreline is the physical connection between land and water; warm and cold water; forest, meadow, and marsh. It is, indeed, a life belt.

Among previously identified habitat issues are:

- how best to preserve remaining habitat from loss or degradation;
- how to evaluate offers to create habitat;

- what programs and policies are needed to restore and enhance habitat, and where efforts should be concentrated.

Planning for Habitat

No one plans for habitat destruction but, to take a euphemism much in vogue during the war in the Persian Gulf, there has been "collateral damage" and its accumulated effects are becoming very serious indeed. A healthy habitat, on the other hand, contributes to five of the Royal Commission's nine principles for a better waterfront: that it should be clean, green, connected, diverse, and attractive.

Habitat and the presence of certain species indicate the degree to which the environment is clean, while its greenness summarizes a range of natural, vibrant elements that help support the biosphere, and are a soothing antidote to urban concrete, steel, and glass. The shallow waters of the lakeshore connect the tributaries, and the beaches provide the transition from water to land. The different forms and colours found in natural habitat make the shoreline more attractive and contribute to diversity of species and landscape.

The current planning process has allowed, and perhaps even encouraged, habitat destruction. It is clear that a different approach is needed — one that reflects the new priorities and improved understanding of the importance of terrestrial and aquatic habitat. Central to that perception is an understanding that a great deal of past damage is the result of narrow project-by-project evaluation, and failure to consider cumulative effects. In this context, an ecosystem approach and an integrated GTB shoreline plan are proposed.

An ecosystem approach to planning and design requires fundamental changes to decision-making and implementation processes. Biological needs must be defined so that the impact of proposed alterations to the shoreline can be evaluated. Beyond defending what exists, positive measures must be taken to make habitat restoration a regional goal and an objective for projects on the shore. Without goals and activities to increase and enhance the quantity and quality of habitat, both will continue to be lost.

The proposed GTB Shoreline Plan would be particularly helpful in addressing habitat needs. First, the shore is diverse, and the potential for habitat varies widely. The plan would permit habitat restoration and enhancement efforts in the area offering the best opportunities for it. For example, efforts to stimulate habitats for warm-water fish like muskellunge are more likely to succeed if locations are chosen along the whole GTB shore, including the Toronto Islands, rather than only the exposed Halton shore. Second, the potential of a framework plan to consider cumulative effects will help ward off the piecemeal loss of existing habitat.

Recommendation

The GTB Shoreline Plan should include explicit goals and objectives to protect existing habitat, restore what has been degraded, and enhance habitat for native species.

Preserving Existing Habitat

Shoreline and river valley wetlands are among Ontario's most important — and most threatened — habitat. Successive Ontario governments have been studying and considering options for many years. While there has been a wetlands policy in draft form since 1989, it is urgent that the Province adopt an official position on wetlands.

Recommendation

The Provincial Draft Wetland Policy Statement should be adopted under Section 3 of the Planning Act.

There is a need to regulate the treatment of wetlands; protect them from activities that degrade them, directly or indirectly; and require that they be restored or that damage be mitigated. The Fisheries Act has the potential to provide such regulation for estuarine marshes, but other measures such as the Conservation Lands Act or a new Wetlands Protection Act are needed to address upstream wetlands not covered explicitly by the fisheries legislation.

In Chapter 3, the Work Group discussed the fact that failure to apply existing laws in a consistent and effective way has contributed significantly to failure to regenerate the shoreline. There will be a substantial period before a GTB Shoreline Plan can be developed, agreed to, and implemented, regardless of the implementation approach chosen. Therefore, it is of great importance to defend the remaining shoreline habitat, starting immediately.

Recommendation

Existing legislation should be enforced vigorously as a means of protecting the remaining natural areas, as an interim holding measure pending development of the GTB Plan.

In order to plan for the preservation, it is important to know what we have. In particular, it would be very helpful if existing information were available in a data base that would make it readily accessible and available to be combined with new information.

Recommendation

Existing information about terrestrial and aquatic ecosystems along the GTB shoreline should be assembled, and any significant gaps should be eliminated so that there is a comprehensive inventory as a basis for goals, objectives, and planning.

In defining parts of the shoreline as worthy of protection — whether as Areas of Natural and Scientific Interest (ANSIs), nature reserves or protected ecological zones — the criteria are usually variety, diversity, and ecosystem representativeness. Too often, the perception is that these apply to rural areas, when, in reality, there is a pressing need for nature in the city. In survey after survey, urbanites express a desire to have greater contact with nature closer to home.

From the perspective of ecosystem protection, it is important to create natural links and corridors, to avoid isolated islands. That has become one of the basic elements in the ecological approach to landscape design that is highly developed in the United Kingdom, Holland, Sweden, Denmark, and Germany. It flows from a set of values according to which people are treated as part of nature rather than as separate from it. Concepts of greening the city — whether known as Greenbelts, Greenways or Lifebelts — are part of the move to create and sustain natural land and water habitats near and in urban environments.

This approach of bringing nature and people together plays a vital role in public education and is politically significant. In London, the Camley Street ecological park is a nature reserve of slightly more than half a hectare (1.5 acres) that includes a wetland and a woodland with native plants. It was created in an abandoned railway area and is near low-income, high-density residential areas.

The park has become a neighbourhood centre where science and ecology courses are taught, but — more important — it is maintained with the active help of nearby residents. No longer just another public area, the Camley Street park is a place of great importance and value, where people join together to protect wildlife and, while doing so, nurture themselves and others.

Recommendation

Protection and creation of natural areas and habitat, particularly in urban and near-urban settings, should be given priority in the GTB Shoreline Plan, and in plans for the connected watersheds.

Creating Habitat

Offers to build new habitat to compensate for lost habitat could be made as a way to meet the requirements of a "no net loss of habitat" policy. Promises of "urban fisheries" with recreation and commercial benefits are also very attractive. But efforts to create fish habitat by constructing rubble reefs have not always been successful; part of the problem is that a breeding bed is subject to siltation and other factors that render it ineffective. In addition, there must be the appropriate food sources for all life stages, as well as safety, appropriate temperatures, and other conditions — some of which are imperfectly understood.

Recommendation

Because of the uncertainty of creating replacement habitat, the highest priority should be given to protecting existing habitat and wetlands, particularly in river estuaries, while planning for the regeneration of natural areas and habitats.

Proposals to stimulate fish production in the cells of the Leslie Street Spit are cause for concern: not only will this consume a significant portion of the remaining confined disposal facility (CDF) capacity, it will divert energy and attention from development of habitat that is not surrounded by contaminated sediment.

Recommendation

The GTB Shoreline Plan should emphasize the need to support wildlife diversity throughout the food chain, rather than just concentrating on top predators like salmon.

Recommendation

Any commitment to ameliorating or replacing damaged or destroyed habitat should be considered cautiously; replacement habitat should be substantially larger and more diverse than that which it is replacing.

Options for Habitat Restoration and Enhancement

Significant progress has been made in establishing particular types of vegetation on and near the GTB shoreline; in fact, it is clear that a variety of habitats can be produced in conditions previously thought to be hostile to growth. The best way to make progress is to be sensitive to the biological environment and nature's processes.

There are many opportunities for this approach in parks and on other public lands and private property. For example, the planned expansion of the Ashbridge's Bay sewage treatment plant offers a great opportunity to create better pedestrian and bicycle access to the shoreline, as well as new picnic areas — all in the context of a biologically productive shoreline and nearshore aquatic environment. Landscape management issues should be considered and developed as part of the building program as early as possible in the process.

Wetlands and Wetland Design

Wetlands are among the most productive ecosystems on earth: the plants that grow in them, the particular qualities of their shallow waters, and the organic material that lines them attract other forms of life, including insects, birds, fish, amphibians, and reptiles. Wetlands are a major habitat for many birds and they have a strong impact on the quality and quantity of fish and other resources.

Existing lakefill and shoreline areas should be re-evaluated in terms of their capacity to sustain wetlands. While wetland creation is an emerging art, the use of conservation design, in order to plan for a variety of wildlife habitats may help restore rare, endangered or native plant and animal species, is important to shoreline regeneration. The essentials in creating wetlands include:

- the ability to regulate water elevations;
- grading of substrate materials to a depth of half to one metre (1.1 yards) at low water levels;
- importing soil rich in organic matter to form parent material and rooting zone;
- creating a variety of side slopes from 1:10 and 1:12 to 1:5;
- designing wetland cells or islands with open channel areas separating them to a depth of two metres (2.2 yards) and a minimum width of three-quarters of a metre (.75 yards);
- retaining a 1:1 ratio of open water to wetland area to minimize maintenance problems and to assist in creating duck habitats;
- designing landforms surrounding the wetlands to create varied drainage patterns and modify wind velocity, temperature, and snow deposition;
- creating depressed and irregular grading patterns to trap airborne seeds and assist in establishing colonized plant communities such as cottonwood, aspen, willow, cedar, and dogwood, and woody shrubs.

Wetland creation is not an exact science. However, by working with nature, there is a potential to create worthwhile new habitats.

In part, lakefill proposals should be evaluated for their potential to create new wetlands, and proposals for establishing wetland habitat should be treated as research experiments, requiring proper documentation, base conditions, statements of goals and objectives, accurate information on implementation, and monitoring of results.

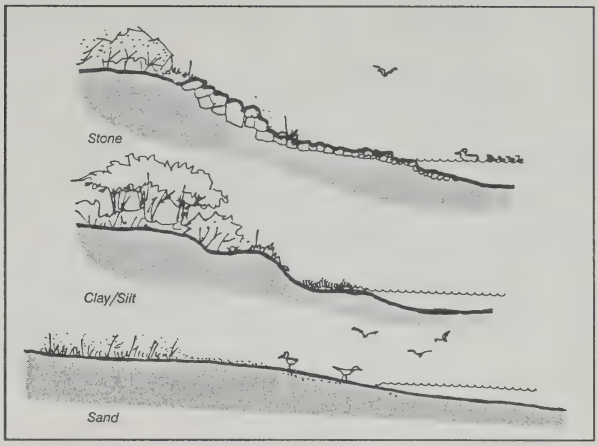
Planning and Design Principles

The following are some principles for conservation design, as they were applied in a plan for Tommy Thompson Park. They should be included in the programming and detailed design stage of waterfront development, in order to aid the overall planning process.

Water Edges

Purpose

To create a variety of natural, self-sustaining, maintenance-free, and diverse plant and animal habitat conditions on the GTB shoreline to enhance the aesthetic qualities of the landscape.



Various edge conditions

In part, this may be done by:

- eliminating straight embankment conditions in order to create banks of variable widths, and modifying all embayment and lagoon areas where these conditions exist;
- creating or maintaining variable slope conditions ranging from 1:3 to 1:12 or less.
- modifying land elevations to create high and low points around embayment and lagoon perimeters;
- creating or maintaining a variety of conditions at the shore's edge, including sand, clay, pebble, and stony areas.

Islands

Purpose

To create habitats for common tern and other bird and fish species.

This may be accomplished by:

- varying their size from 0.4 to two hectares (1 to 5 acres) with irregular shorelines;
- maintaining a 60-metre (66-yard) distance from the nearest embayment shoreline;
- varying the height of islands from a minimum of one metre (1.1 yards) above the high water level to 1.8 metres (two yards);
- maintaining slopes at between 1:4 and 1:10;
- surfacing islands with a sand/fine granular stone material;

- varying water depth and contour conditions around islands;
- maintaining exposure to prevailing winds;

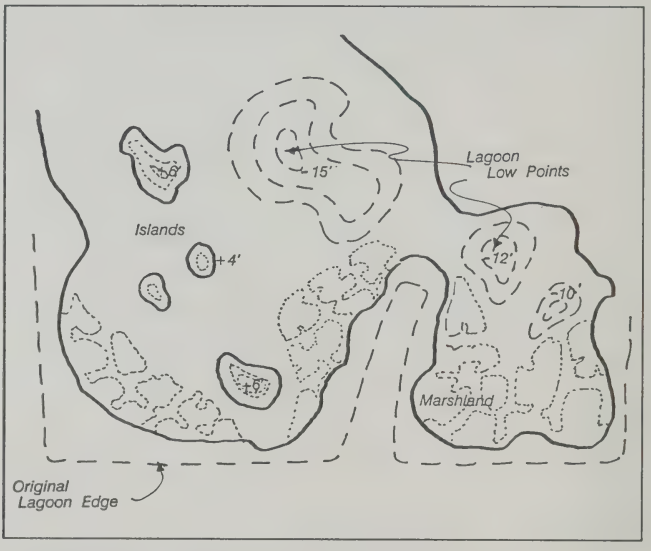
Lagoons

Purpose

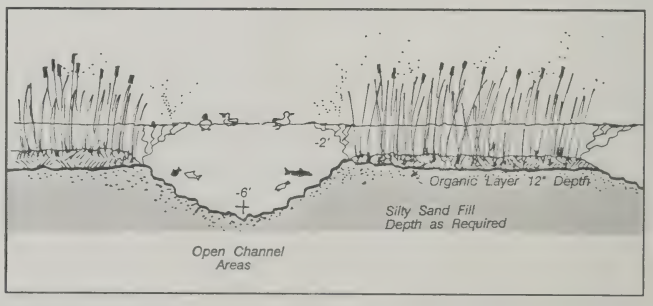
To encourage fish reproduction and sustain fish life by creating and/or protecting natural habitats and creating marshlands.

This may be achieved by:

- providing a variety of water depths as low as 4.5 metres (5 yards);
- sustaining and/or improving water circulation;
- creating a variety of bio-physical conditions for different types of plant and animal life;
- creating conditions that encourage the presence of diverse species of birds, mammals, and fish;
- locating proposed marshlands on the leeward edges of the lagoons to optimize seed collection and dispersal;
- maintaining a ratio of not less than 1:1 open water to vegetated areas;
- developing open water channels and/or creating vegetated islands to enhance bird nesting and habitat opportunities.



Conditions for different plants and animals



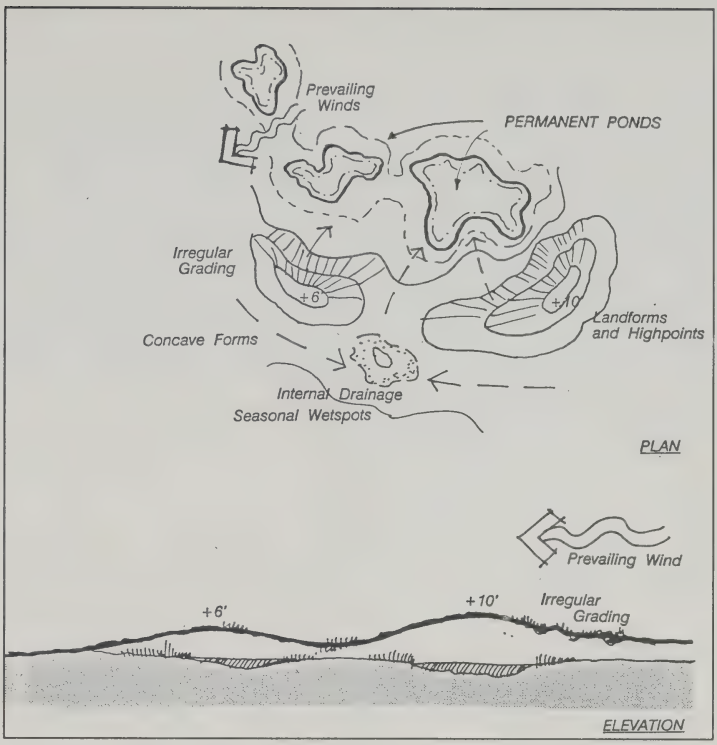
Balanced open water and vegetation

Landform, Grading, and Drainage

Purpose

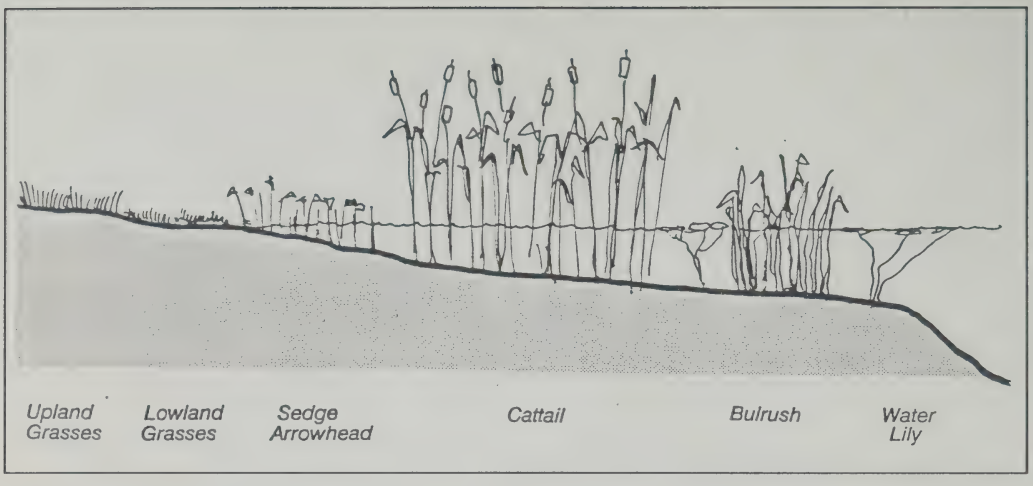
To create a landscape base structure that encourages a variety of plant and animal communities, with their unique aesthetic qualities, to evolve.

In order to do so, it is desirable to:



Grading for plant diversity

- plan a series of high and low elevations for ecological and aesthetic reasons;
- provide a variety of micro-climatic conditions based on prevailing winds, solar exposure, and orientation;
- vary landform heights in an aesthetically pleasing way and allow for visitor vantage points; concave forms should be oriented to prevailing winds;
- create gradual transitions to slopes for a continuous flow of space; 1:1 slopes and right-angle corners should be avoided;
- grade in a way that allows imperfectly drained areas to create localized wet conditions;
- build a series of ponds with varied bands and edges to provide greater habitat and species diversity and a natural feeling; pond depths can vary from 0.6 to 2.5 metres (2 to 8 feet); surface drainage should be positioned in relation to ponds to facilitate water recharge;
- import soils to the site to construct landforms that vary in fertility, but are capable of sustaining a variety of plant materials;
- vary slopes depending on solar and wind orientation to obtain a variety of site moisture and exposure conditions: northern and western slopes can be steeper to hold moisture and create wind traps to collect airborne seeds, while southern and eastern slopes could have more gradual gradients to allow feathered transitions to surrounding land and water environments.



Shallow water areas for various plants

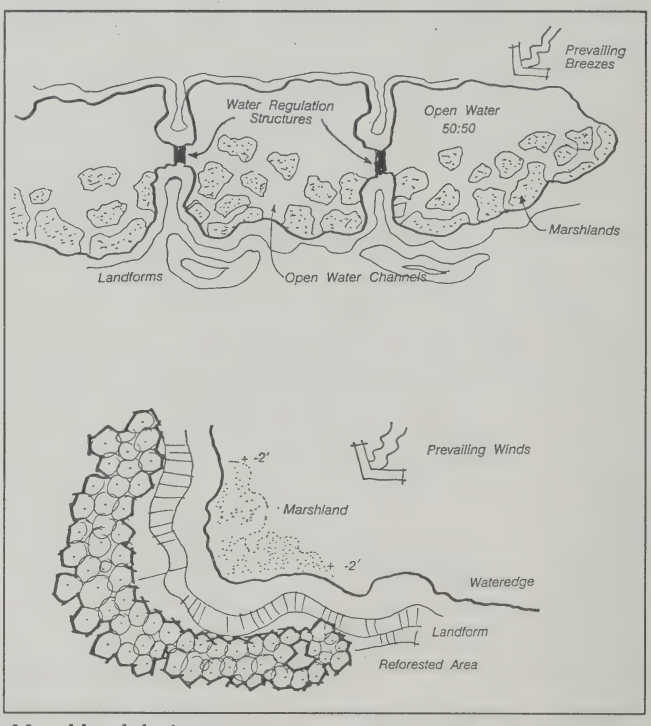
Marshlands

Purpose

To create marshlands in lagoon areas.

This may be done by:

- creating a system of shallow water areas ranging from 15 to 60 centimetres (six to 24 inches);
- regulating water levels if at all possible;
- planting lowland grasses, sedges, cattails, bulrushes, and submergents;



Marshland design

Recommendation

Efforts to create habitat such as wetlands should be actively supported in the GTB Shoreline Plan. They should be treated as experiments, with emphasis on careful design, baseline conditions, controls, and measurement and evaluation of results in order to obtain useful information.

Quality of Life

The shoreline of Lake Ontario has great potential to enrich the quality of life for all residents of the Greater Toronto Bioregion: it can provide a variety of relaxing vistas, pleasing shapes and colours, cool summer breezes, adventures in history, private places, busy places, affordable recreation in the form of exciting sports or restful pursuits, and relief from concrete and glass.

Virtually all of the issues in this report relate in some way to the quality of life in the GTB. The major quality of life issues which remain to be discussed relate to the aesthetic consequences of shoreline modification, and physical, perceptual, and economic access.

Aesthetic Considerations

A good shoreline offers quality and variety: a waterfront trail that people will use because of its convenience, a range of facilities, and scenic pleasures. Most lakefill and shoreline regeneration projects lack these qualities, as they reflect hard, technical solutions and sterile landscapes. Too often, the smallest possible budget is allocated to landscape development, which is too often seen as a left-over after the construction — "the important stuff" — has been completed.

Greater concern for good design is required and more attention should be given to fostering diverse ecosystems in lakefill projects and shoreline regeneration plans. Grass lawns and lollipop-shaped trees are not always the most appropriate design or ecological expression for the waterfront. There is a need for more native species and a variety of grasses, shrubs, and trees to create habitat that attracts more animal and bird species. At the same time, that less controlled approach will provide variety and enhance the aesthetic qualities of the landscape.

Recommendation

Municipalities, conservation authorities, and other major shoreline landowners should prepare comprehensive landscape inventories as a basis for assessing visual quality and the need for landscape remediation to ensure the long-term aesthetic quality of the waterfront.

Physical, Perceptual, and Economic Access

Physical, perceptual, and economic access to the shoreline is important to the quality of life of residents and visitors.

Physical access, the public's ability to reach the waterfront, is an important first condition. Consistent, comprehensive policies integrating access points, roads, public transportation, bikeways, and trails into the official plans of municipalities are needed. Linear connections are especially necessary to create a continuous waterfront trail system.

Enjoying the beach in Oakville

Proposals for lakefill and shoreline modification have enhanced point source access and can encourage an overall trail plan based on the principles of a connected, accessible, usable, affordable, diverse, clean, and green waterfront. The Royal Commission's idea of a continuous waterfront trail system is an excellent example of enhanced physical access.

Perceptual access means that the public feels safe and confident in using the access available and, once at the waterfront, feels comfortable and welcome by the shore. Crossing six lanes of busy arterial roads, or traversing 200 metres (220 yards) of the dark York Street tunnel discourages the waterfront visitor. Once at the shoreline, the towering condominiums close by make the status of the walkway ambiguous. Welcoming signs, pleasant walks, appropriate shrubbery — all can contribute to a sense that the waterfront is a welcoming public place.

Economic access — that is, the ability of people at various economic levels to visit the waterfront — is largely a function of access by public transportation and public ownership of property at regular intervals along the shore. It isn't necessary that all these public spaces be highly developed: there should be a variety of opportunities to approach or view the waterfront, including paths, beaches, picnic places, and launching and mooring facilities available for public use. Goals for public access should be an integral part of any GTB Shoreline Plan.

CHAPTER 5

IMPLEMENTATION

The Work Group has outlined the need to protect and regenerate the Greater Toronto Bioregion shoreline, and has recommended that the federal and provincial governments adopt this goal. Given the many ministries, regions, municipalities, and authorities involved, we endorse a co-operative approach and a planning framework, referred to as the GTB Shoreline Plan. The goals, objectives, and plans for protecting and enhancing the shoreline can be agreed to within the context of the plan.

Having identified the goal and the planning mechanism, we now turn to some prerequisites for success, elements in developing the plan, and options for implementing it.

Leadership

Achievement of the goals clearly requires political leadership. Given the nature of Canadian constitutional arrangements, the federal government has a substantial influence over the regeneration of the Toronto waterfront. On the west coast, the federal government has been very active, and a leading participant in the innovative Fraser River Estuary Management Plan (FREMP) On the Toronto waterfront, it has played a less prominent role — except for a few grand gestures, like Harbourfront. The GTB Shoreline Plan offers Ottawa an opportunity to be more actively involved, and bring its expertise, legislative clout, and experience in FREMP to bear on improving a high-profile area.

The Province of Ontario has the greatest potential for leadership in determining the future of the Lake Ontario shoreline: it has substantial responsibility for environmental protection and land-use planning, two key issues in shoreline regeneration. However, the Province has generally left shoreline planning for the area in the hands of the 11 local municipalities, four regional municipalities, and five conservation authorities operating in the GTB.

This report has identified five barriers to shoreline regeneration:

- gaps in the regulatory framework;
- fragmented jurisdiction;
- lack of an overall plan;
- an inadequate approval and monitoring process; and
- lack of effective public involvement.

Given these problems, there is a clear need to bridge jurisdictional gaps to achieve important shoreline goals. It is equally clear that both Canada and Ontario have the powers needed to overcome those barriers. An effective partnership between them, and commitment to shoreline regeneration, would ensure its success.

Developing the GTB Shoreline Plan

Chapter 4 included a description of the form an integrated shoreline plan might take. There are a number of prerequisites for development of such a plan.

In order to develop it, interested parties need an incentive to negotiate, compromise, and reach agreement. Certainly, a government moratorium on new projects, pending completion of a plan, would provide such an incentive.

Moreover, it is important not to have choices compromised by major projects or undertakings while the plan is being developed. A moratorium would provide the necessary assurance of both negotiation in good faith, and something left to manage once the plan was complete. The same could be said of the alienation of waterlots.

Recommendation

The Government of Canada and the Province of Ontario should impose a moratorium on new lakefill projects until the GTB Shoreline Plan is prepared, with appropriate exemptions for emergency erosion control projects.

Because considerable potential capacity exists in the Leslie Street Spit, such a decision would not constrain development there for five years or more.

Recommendation

Ontario should not allow existing waterlots to be sold to private interests and it should prohibit creation of new waterlots until the GTB Shoreline Plan has been completed.

Adequate Resources

A good plan is impossible unless it is backed by adequate financial resources. While good use of existing funds would be helpful, "new money" would be required for a meaningful regeneration effort.

Recommendation

The Canadian and Ontario governments should provide financial support for the preparation and execution of the GTB Shoreline Plan.

Recommendation

The plan should include a budget for implementing regeneration projects, as well as appropriate mechanisms for funding them from public and private sources.

Adequate Data

Without adequate data, or without effective access to existing data, planning is done in the dark, which is almost always counter-productive.

Recommendation

The plan should be supported by adequate research and data on the area to be managed, and such data should be organized in compatible computerized forms for easy access and management.

Controlling Pollution

It is clear that regeneration of the shoreline depends on a plan based on programs that deal with upstream pollution sources.

Recommendation

The shoreline regeneration plan should build on existing pollution control measures such as the Great Lakes Water Quality Agreement (GLWQA), Municipal/Industrial Strategy for Abatement (MISA), Remedial Action Plan (RAP), Clean Air Plan (CAP), and combined sewer separation. Furthermore, the MNR Draft Flood and Erosion Control Policies, enhanced to include sustainable development not just erosion control, should be integrated with the plan.

Public Involvement

In the past, public involvement in shoreline issues has been sporadic and usually limited to a specific project. The Work Group found that interest in shoreline regeneration has grown substantially in recent years. Given projections of increased population, renewed interest in the shoreline as a desirable location for a variety of activities, and greater concern about the environment, public interest in shoreline regeneration will continue to increase.

The Group believes that both federal and provincial levels of government should encourage public participation in a variety of ways, including involving the community in preparing the shoreline regeneration plan — participation that should be backed by intervenor funding to assist groups involved in hearings on the plan.

Alternative Approaches to Implementation

The powers needed to develop and implement the GTB Shoreline Plan could be obtained through different mechanisms. The following is a list of the alternatives:

- new legislation (e.g., a GTB Shoreline Protection and Planning Act);
- amendments to existing legislation;

- policy statements and declarations of interest; and
- co-operative agreements, perhaps modelled on the Fraser River Estuary Management Program (FREMP).

None of these approaches is novel, and each has advantages and disadvantages.

New Legislation

The federal government, in conjunction with the Province of Ontario, could pass new parallel legislation to protect, manage, and enhance the Lake Ontario shoreline between Burlington and Newcastle.

There are few precedents for federal-provincial legislation mainly in the control of transportation of dangerous goods. The advantages of that legislative approach include the importance it gives the issue, and the strong task-specific regulatory framework it creates. Moreover, any attempts to weaken a new act would have to be carried out in public, making changes to it difficult.

There is a great deal of related legislation already in place (as outlined in Chapter 4), and there would be a period of conflict and uncertainty while precedence was sorted out; there might even be a risk that federal legislation would be declared ultra vires.

A second approach employing new legislation would have the province introduce an act similar to the Niagara Escarpment Planning and Development Act. A brief examination of the legislation establishing the Niagara Escarpment Commission (NEC), and its applicability to the GTB shoreline, suggests some advantages and disadvantages. The clarity and authority of a special act has appeal, and the fact that changes would be subject to debate in the legislature provides greater assurance of continuity. On the other hand, the GTB plan may need a more co-operative approach to the municipalities and regions.

When it was created, the NEC had to deal with municipalities and individuals largely unconcerned about protecting natural values. The Act setting up the Commission gave it a clear mandate and development control powers to achieve its goals, which have many similarities to what is needed on the GTB shoreline. There are some differences, however.

The Niagara Escarpment Commission, which is a provincial agency, is not in a position of potential disagreement with such powerful entrenched federal organizations as the Board of Toronto Harbour Commissioners, the Small Craft Harbours Directorate of the Department of Fisheries and Oceans. Provincial GTB shoreline legislation would need some sort of Canada-Ontario agreement to formalize the partnership. It should be noted that the NEC literally controls

the escarpment high ground; by contrast, the shoreline will continue to receive a variety of stresses from remote areas over which any new agency or plan would have little direct influence. Therefore, a more flexible and co-operative approach may prove desirable in the case of the GTB waterfront.

Legislative Amendments

Both interim reports of the Royal Commission have pointed out shortcomings in the ability of the present land-use process to incorporate environmental concerns. The Commission has investigated ways and means of doing so and discussed the problem in its report *Planning for Sustainability.*

As a first step, the Planning Act could be amended to give higher priority to the goals of conservation and enhancement, and give municipalities the power to control land uses that might lead to destruction of shoreline vegetation and habitat, and to control creation of new land by lakefilling.

Legislative amendments may take years to pass and often involve compromises; once they become part of the law, there is a learning period during which new mechanisms are put in place. It is not clear how this approach would achieve the objective of an integrated plan crossing many municipal borders, and it has many weaknesses.

Policy Statements and Declarations of Interest

Provincial policies can be articulated through policy statements or declarations of interest under the Planning Act, without the need to amend legislation. (Existing Policy Statements, on subjects such as Affordable Housing and Flood Plains, have had a substantial impact on planning in Ontario.) The Ministry of Municipal Affairs, in conjunction with the Ministry of the Environment and the Ministry of Natural Resources, could formulate policies for protecting, enhancing, and planning shoreline areas; clearly, all municipalities and government agencies would be required to act in accordance with such policies.

The Minister of Municipal Affairs could declare a provincial interest along the shoreline from Burlington to Newcastle, or in those parts under especially intense development pressure. All development proposals of more than a certain amount would then be subject to greater scrutiny from provincial staff. However, this case-by-case approach does not take into consideration the cumulative effects of development; the danger is that the focus might easily switch from planning goals to dealing with daily demands for exemptions. Experience has shown that declarations of interest take about as long as legislation, and the results in the end may not be strong enough to achieve the goals set out in this report.

Co-operative Agreements

The Memorandum of Understanding (MOU) is the mechanism for formalizing a partnership between governments and agencies. FREMP was set up this way, with the federal and provincial governments participating in a central committee as "senior partners," with room for broad involvement by agencies and municipalities. This approach is flexible, requires no new legislation, and can get started quickly. However, there is no express route to establish a multi-jurisdictional planning framework. It would also take time to produce co-operative agreements under a MOU amongst interested government departments and agencies. Inevitably, extended negotiations are needed to reach sound agreements. While this is the most flexible approach, it is subject to breakdown if one or more of the partners fail to live up to the spirit of the agreement.

Summary of Approaches to Implementation

None of the four approaches to implementing the waterfront plan is uncomplicated or speedy. Legislation is the strongest form, while MOUs offer the greater flexibility and the best opportunity for co-operation from existing agencies.

Within the broad framework of the plan, there are several flexible tools which could be employed to address local situations, projects or segments of the plan. These include Waterfront Partnerships, Land Trusts, and the Royal Commission's proposal for a Waterfront Regeneration Trust.

Waterfront Partnerships

The *Watershed* report suggests waterfront partnerships that would include the federal, provincial, and municipal levels of government. The Minister of the Environment endorsed this concept, and many municipalities have shown interest in it. Additional partnerships should be encouraged, particularly for those parts of the shoreline that offer the best opportunities for preserving the waterfront. We hope every waterfront partnership will encourage citizen participation.

At the same time, we recognize that there is fierce competition for a place on the public agenda and contributions from the public purse. Therefore, governments should encourage, but not totally subsidize or control, voluntary groups with interests in shoreline regeneration. For example, the proposed waterfront trail has already resulted in the formation of a group, Citizens for a Lakeshore Greenway, which will probably act as an advocate/watchdog to ensure that the trail is completed, maintained, and utilized.

Land Trusts

While governments have the power of expropriation, they face many competing demands for funds, and often lack the ability to act quickly and creatively

in changing circumstances. Careful consideration should be given to establishing one or more land trusts to purchase and hold undeveloped shoreline land, to ensure that it stays in public hands.

Land trusts are used in many jurisdictions to acquire land to be held in the public domain. Some are heavily involved in acquiring land and conserving public easements, while others take part in joint government/non-government programs to achieve their goals. For example, in Cape Cod a local conservation trust acquired and held a waterfront property until the local municipality had sufficient time to raise the necessary funds to take it over.

Waterfront Regeneration Land Trust

The *Watershed* report recommended creation of a Waterfront Regeneration Land Trust that would go beyond the conventional role of acquiring and holding land; it would actively carry out rehabilitation and restoration projects. Various levels of government, as well as private citizens, could be represented in the Waterfront Regeneration Land Trust. However, the Trust should be independent of all levels of government for its day-to-day operations in order to act flexibly, respond quickly, and raise private-sector funds more easily.

The Waterfront Regeneration Land Trust may prove to be a valuable vehicle for shoreline regeneration; it should pursue only those shoreline modifications that meet ecological criteria and ensure that newly created lands remain in public ownership for the benefit of future generations. The Work Group views this as a powerful innovation and a useful tool to achieve certain objectives within the overall plan.

Summary

Protecting and regenerating the GTB shoreline must take place within the framework of a plan that integrates various municipal and provincial activities, and that channels energy towards those goals.

A moratorium on new lakefill projects is necessary to move various parties to negotiate and finalize the plan, and to avoid actions that compromise the plan even before it is completed.

There are many possible approaches to implementing the plan, including passing new legislation, amending existing legislation, issuing policy statements and declarations of interest, and establishing co-operative agreements. Irrespective of the approach taken, flexibility and creativity are the keys to implementing the plan in the context of many competing interests within communities. Negotiating partnership agreements among governments and using the Waterfront Regeneration Land Trust to acquire and rehabilitate land would greatly assist in reaching shoreline regeneration goals.

There are two essentials, no matter what avenue is used in developing a shoreline regeneration plan:

- the two senior levels of government must provide leadership;
- the public must be involved at each stage if people are to understand, accept, and support the goals, objectives, and constraints of a plan.

Clearly, complex and challenging tasks lie ahead. The reward for success, however, will be a healthier waterfront, offering affordable recreation, scenic beauty, employment, culture, drinkable, swimmable water, edible fish, and a place of pride and pleasure at the doorstep of millions. What better use could we make of our talents than to create such a gift for our children and grandchildren?

Toronto's central waterfront viewed from the Toronto Islands

GLOSSARY

Artificial Nourishment: The process of replenishing a beach with material (usually sand) obtained from elsewhere. Also called "beach nourishment".

Beach: The zone of unconsolidated material (sand and gravel) that extends from backshore lakeward to the low water line.

Beach Starvation: The loss of beach-building materials (usually sand and gravel) arriving at a site, as a result of updrift alterations interfering with the normal supply of sand.

Bluff: A high, steep cliff or bank.

CDF: Confined Disposal Facility, normally a facility for deposit of contaminated dredge spoil (sediments) where those sediments are contained in some way to prevent dispersion in the surrounding lake waters.

CSO: Combined Sewer Outfall.

Downdrift: The direction of predominant movement of littoral materials (sand and gravel).

Embayment: An indentation in the shoreline, forming an open bay.

Groyne: A shore protection structure built (usually about perpendicular to the shoreline) to trap littoral drift and thereby retard erosion of the shore. Impermeable groynes are those which sand cannot pass through; sand can pass through permeable groynes.

GTB: Greater Toronto Bioregion includes the shoreline from Burlington to Newcastle, and the watersheds draining into Lake Ontario between those communities, roughly the area bounded by the Niagara Escarpment zone and the Oak Ridges Moraine. (See Figure 16.)

Headland: A promontory extending into the lake.

IBI: Index of Biotic Integrity, or Integrated Biotic Index, is an indicator number employed by biologists to assess the health of a fish community in terms of species composition, trophic composition, and health and abundance of fish.

Lakefilling: The practice of displacing the lake to create new land by depositing rubble, excavation materials, dredge spoils, and other materials.

Littoral: Of or pertaining to the shore. See "littoral zone".

Littoral Cell: A segment of shore where there is little supply or loss of littoral drift to adjacent littoral cells.

Littoral Current: Any current in the nearshore zone. Caused primarily by wave action (longshore current, rip current). See also "longshore current".

Littoral Deposits: Deposits of littoral drift.

Littoral Drift: The sedimentary material moved in the littoral under the influence of waves and currents.

Littoral Transport: The movement of littoral drift in the littoral zone by waves and currents. Includes movement parallel (longshore transport) and perpendicular (on-offshore transport). Includes "potential sediment transport rate" (the amount of material that *could* be moved given the available wave energy if there was an infinite supply of material) and the "actual sediment transport rate", that is, the amount of material actually moved.

Littoral Zone: The zone extending lakeward from the shoreline to just beyond the breaker zone.

Longshore: Parallel to and near the shore.

Longshore Current: The littoral current in the breaker zone moving essentially parallel to shore, usually caused by waves breaking at an angle to the shoreline.

MTRCA: Metropolitan Toronto and Region Conservation Authority.

Nearshore (Zone): In beach terminology, an indefinite zone extending lakeward from the shoreline to the outer edge of the breaker zone.

Offshore (Zone): In beach terminology, the zone extending lakeward from the breaker zone.

Recession: A horizontal landward movement of the shoreline.

Regenerate: (for the purposes of this report) To employ the policies, practices, and technologies needed to restore the waterfront so that it is "clean, green, useable, diverse, open, accessible, connected, affordable, and attractive".

Revetment: A facing or sheathing, typically stone or concrete, for protecting earthworks, riverbanks, etc. from erosion.

Riparian: Pertaining to the banks of a body of water.

Sand Bypassing: The movement of sand accreting updrift, bypassing some feature to the downdrift side. Can be either hydraulic (natural) or mechanical (caused by man).

Seawall: A structure at the margin of the lake primarily designed to prevent erosion of a bluff by wave action.

Sediment Budget: A calculation or budget of the amount of sediment supplied (by sediment sources), transported, and deposited (in sediment sinks) at the coast.

Sediment Compartment: Refers to a coastal sediment system which encompasses two littoral cells supplying depositional material to a common sink zone.

Sediment Sink: The areas where sediment is removed from the littoral transport system.

Sediment Source: An area that supplies sediment to the littoral system.

Slump: A failure of a bluff slope with mass movement along a failure plane.

STP: Sewage Treatment Plant.

Till: A mixture of clay, sand, silt, gravel, and boulders deposited by glaciers.

Tipping fees: Fees charged by lakefill or landfill operators such as MTRCA to dump material into a designated area.

Toe Erosion: Erosion which occurs at the base of a bluff (toe) largely as a result of removal of material by wave action.

Turbid: Opaque or cloudy, in the case of water, a condition caused by suspended silt and/or algae.

Updrift: The direction opposite that of the predominant movement of littoral materials (sand and gravel).

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Figure 1:

Greater Toronto Area Shoreline Lakefill Projects